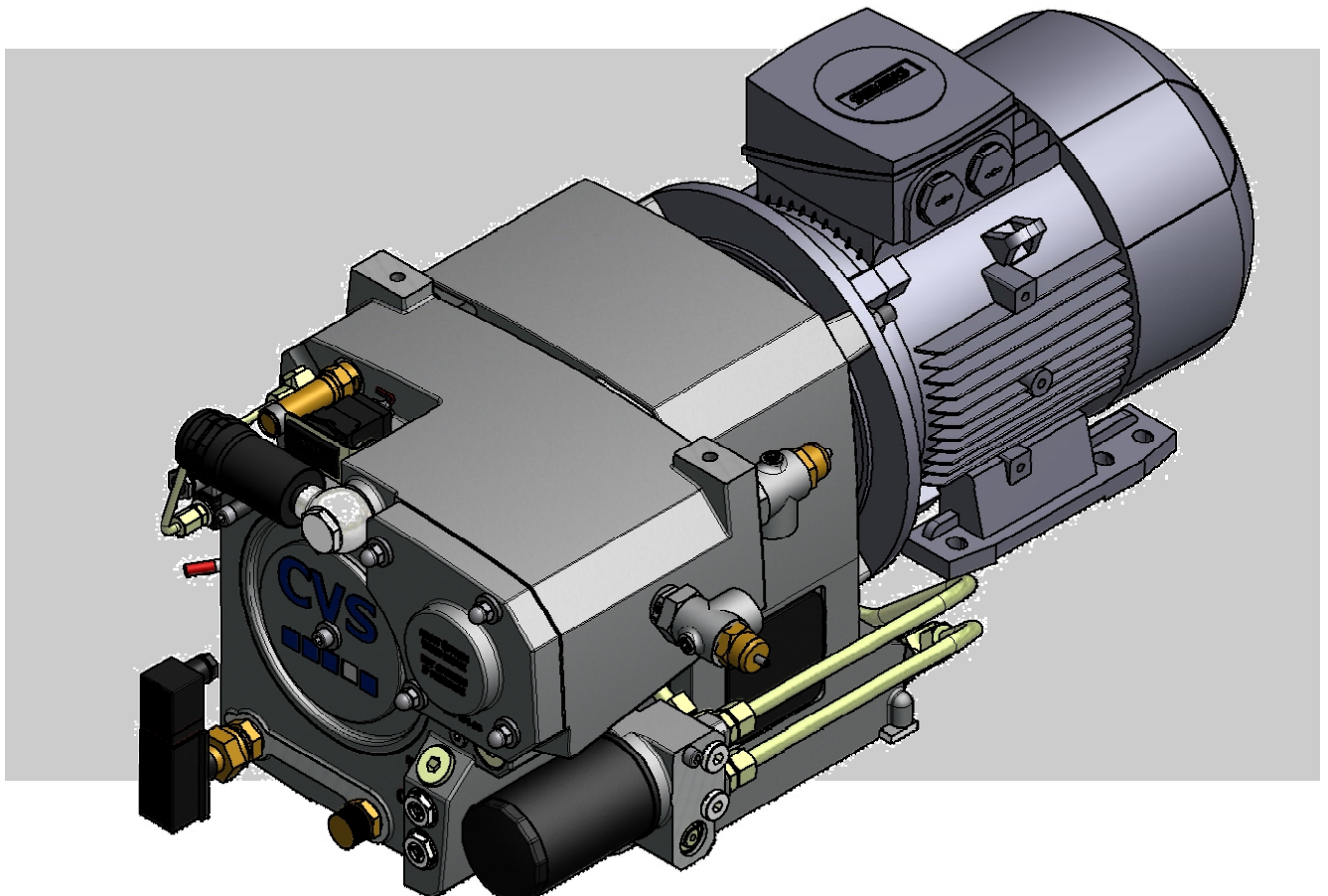


# Operating instructions

**CVS Compressor  
RPO 200/300/400/600/800**



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**The operating instructions must be read by the machine operator and before start-up!**

## Translation of the original operating instructions

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## General

# 1 General

## 1.1 Information regarding the operating instructions

These operating instructions provide important information on how to deal with the RPO compressor.

A precondition for safe operation is the observance of all safety and handling instructions specified in these operating instructions.

Furthermore, all local accident prevention regulations and general safety regulations valid for the application area of the machine must be observed.

Carefully read the operating instructions before starting any work! They are a product component and must be kept in direct proximity of the machine, well accessible to the personnel at all times.

When passing the machine on to third parties, the operating instructions must also be handed over.

## 1.2 Pictogram explanation

### Warning notes

Warning notes are characterised by pictograms in these operating instructions. The warning notes are precluded by signal words expressing the scale of the hazard.

It is absolutely essential to observe the notes and to proceed with caution in order to prevent accidents as well as bodily injuries and property damage.



#### **DANGER!**

... points to an immediately dangerous situation, which will lead to death or serious injuries if it is not avoided.



#### **WARNING!**

... points to a potentially dangerous situation, which may lead to death or serious injuries if it is not avoided.



#### **ATTENTION!**

... points to a potentially dangerous situation, which may lead to minor or light injuries if it is not avoided.



#### **CAUTION!**

... points to a potentially dangerous situation, which may lead to property damage if it is not avoided.

### Hints and recommendations



#### **NOTE!**

... highlights useful hints and recommendations as well as information for an efficient and trouble-free operation.

## General

### 1.3 Limitation of liability

All specifications and notes in these operating instructions were compiled with consideration to the valid standards and regulations, the state of the art as well as to our long-standing knowledge and experience.

The manufacturer is not liable for damages caused by:

- Non-observance of the operating instructions
- Improper use
- Deployment of non-trained personnel
- Arbitrary modifications
- Technical changes
- Use of non-approved spare and wear parts

The actual scope of supply may differ from the explanations and illustrations described in this manual in case of special designs, if additional order options are made use of, or due to latest technical changes.

Incidentally, the responsibilities agreed upon in the delivery contract, the general terms and conditions as well as the manufacturer's conditions of delivery and the statutory provisions valid at the time of contract conclusion shall apply.

### Warranty

The manufacturer guarantees the correct functioning of the applied process technology and the performance parameters identified.

The warranty period commences on the date the machine is delivered to the customer.

Components are exempted from the warranty and from claims for defects as far as wear and tear damage is concerned.

→ Also see page 80, Chapter 10.2.

### 1.4 Copyright protection

Surrendering the operating instructions to third parties without written permission of the manufacturer is not permitted.



#### NOTE!

*Content details, texts, drawings, pictures and other illustrations are protected by copyright and are subject to industrial property rights. Any improper use shall be liable to prosecution.*

Any type and form of duplication – also of extracts – as well as the exploitation and/or communication of the contents are not permitted without the manufacturer's written declaration of consent.



## 1.5 Scope of delivery and goods receiving

Immediately check the delivery after receipt for completeness and transport damages. The scope of delivery is indicated on the delivery note.

Proceed as follows in the case of outwardly recognisable transport damage:

- Do not accept the delivery or only under reserve.
- Note the extent of damage on the transport documents or on the delivery note of the forwarder.
- Lodge complaint.



### **NOTE!**

*Lodge a complaint for each defect, as soon as it is recognised. Compensation claims can only be submitted within the valid complaint periods.*

## 1.6 Spare parts



### **WARNING!**

#### **Risk of injury by incorrect spare parts!**

Incorrect or defective spare parts can result in damage, malfunctions or total failure and also impair safety.

Therefore:

- Use only the manufacturer's original spare parts.

Procure spare parts from authorised dealers or directly from the manufacturer. Refer to page 2 for address.

## 1.7 Warranty conditions

For warranty conditions refer to the "General Terms and Conditions".

## **General**

### **1.8 Customer service**

Our customer service can be contacted for any technical advice.  
Information about the responsible contact person can be retrieved by telephone, fax, E-mail or via the Internet at any time, refer to manufacturer's address on page 2.

### **1.9 Declaration of conformity**

Declaration of conformity (pursuant to EC Machinery Directive 2006/42/EC, Annex II A), refer to page 82.

## 2 Safety

### 2.1 Intended use

The RPO compressor is intended exclusively for the compression of cleaned, atmospheric air.

Only use machine for the intended use.

All specifications in the operating instructions must be strictly adhered to (technical data, operating data, permissible working range), refer to chapter in this regard.

Any types of claims due to damage arising from improper use are excluded. The operator alone shall be responsible for any damage arising from improper use.

### 2.2 Operator's responsibility

The machine is used for industrial purposes.

The operator of the machine is therefore subject to the legal obligations concerning operational safety.

The provisions valid at the place of installation as well as the safety and accident prevention regulations of the Institution for statutory accident insurance and prevention must be observed. The operator must in particular:

- inform himself on the valid industrial safety regulations.
- determine the additional hazards that arise from the special working conditions at the machine's place of installation by means of a hazard assessment.
- implement the necessary rules of conduct for operation of the machine at the place of installation by means of user instructions.
- check at regular intervals during the machine's entire period of use whether the user instructions correspond to the current state of the body of rules and regulations.
- adapt the operating instructions – if necessary – to the new regulations, standards, and operating conditions.
- clearly regulate the responsibilities for installing, operating, maintaining and cleaning the device.
- ensure that all employees working on or with the machine have read and understood the operating instructions. In addition he must at regular intervals train the employees in how to deal with the machine and inform them about potential hazards.

## Safety

In addition, it is the operator's responsibility to ensure that:

- the machine is always in a technically perfect condition.
- the machine is maintained in accordance with specified maintenance intervals.
- all safety devices are regularly examined for completeness and operability.

## 2.3 Operating personnel

### 2.3.1 Requirements



#### **WARNING!**

#### **Risk of injury in case of inadequate qualification!**

Improper handling can lead to considerable bodily injuries and property damage.

Therefore:

- Have any activities only carried out by the individuals designated for that purpose.

The operating instructions specify the following qualification requirements for the different fields of activity:

- **Instructed persons**  
have been instructed during instructions provided by the operator with regard to the work assigned to them and possible hazards arising from improper conduct.
- **Specialised staff**  
is due to its technical training, knowledge and experience as well as due to its knowledge of the pertinent regulations able to carry out the work assigned to it and to independently recognise potential hazards.

## 2.4 Personal protective equipment

When handling the machine, it is necessary to wear personal protective equipment, in order to minimise health hazards.

- Before carrying out any work, properly don the necessary protective equipment such as gloves, safety goggles, etc. and wear during work.

## 2.5 Occupational safety and special dangers

The remaining risks that result from the hazard analysis are specified in the following section.

Observe the safety notes listed here and the warning notes in the other chapters of these instructions to reduce health hazards and to avoid dangerous situations.

### **Danger pictograms on the device**

The relevant dangerous spots on the machine are identified by these pictograms:



**DANGER!**  
**Mortal danger due to electric current!**

... identifies life threatening situations caused by electric current. Non-observance of the safety instructions can result in severe injuries or death. Necessary work may only be carried out by an electrical specialist.



**DANGER!**  
**General danger pictogram!**

... denotes general dangerous situations for individuals. Non-observance of the safety instructions can result in severe injuries or death.



**DANGER!**  
**Danger of burns!**

... denotes the presence of a hot surface.

## Safety

### Hazard notes and occupational safety

For your own safety and that of the machine, the following information must be observed and complied with:

#### Improper operation



#### **DANGER!**

#### **Danger due to improper operation!**

- Only use machine in a perfect technical condition. Malfunctions that are relevant for safety have to be promptly eliminated.
- Conversions of the machine are not permissible and can impair safety.
- Before carrying out regular maintenance, cleaning and repair work, switch off power supply and secure machine against restarting (switch off drives).
- Never bridge any safety equipment or put it out of operation.
- Any work on the machine and/or on electrical equipment must be carried out by specialised staff.
- Repair and maintenance work may only be carried out when the machine is stationary. For this, the machine must be secured against restarting!
- The machine may not be under pressure or negative pressure while work is being carried out on it.  
Close the shut-off valve on the vehicle side and vent the line between the machine and the shut-off valve. Manually relieve the compressor overpressure at the safety valve. Observe pressure gauge!
- The drive's protective equipment may only be removed when the machine is stationary and has to be correctly refitted after completion of work.
- Only dismantle accidental contact protection after machine and pressure pipe have cooled down.
- It is an environmental protection requirement that any liquids arising during maintenance work (e.g. oil) must be collected and disposed of in an environmentally compatible manner.

## Moving components



### **WARNING!**

#### **Risk of injury by moving components!**

Powered rotating components can cause the most serious injuries!

Therefore during operation:

It is absolutely forbidden for persons to stay in the hazard area or in the immediate vicinity!

- Do not put safety devices and/or functions out of operation and do not render them inoperative or bypass them.
- Never reach into open outlets and inlets or into running equipment.

Before entering the hazard area:

- Switch off power supply and secure against re-starting.
- Wait for standstill of lagging components.
- Wait for automatic dissipation and/or discharge of residual energies (compressed air).

## Compressed air



### **WARNING!**

#### **Risk of injury due to compressed air!**

Pneumatic energies can cause the most serious injuries.

In the case of damage to individual components, air can be discharged under high pressure and injure e.g. the eyes. Therefore:

- Before starting any work, first depressurise pressurised components. Pay attention to accumulators. Accumulator pressure must also be completely relieved.

## Signposting



### **WARNING!**

#### **Risk of injury due to illegible pictograms!**

Labels and signs can become dirty or unrecognisable in the course of time.

Therefore:

- Always keep safety, warning and operating instructions in a well legible condition.
- Immediately replace damaged or obliterated signs or labels.

## Safety

### Improper transport



#### **DANGER!**

#### **Danger by falling down or tilting of the machine!**

The weight of the machine may injure a person and cause serious bruising!

Therefore:

- Depending on the dead weight and size of the machine, use a pallet on which the machine can be moved by means of a fork lift.
- For lifting the machine, use suitable lifting gear (slings, etc.) that is designed for the weight of the machine.
- When putting the slings in position, take care to avoid putting stress on individual components.
- Only use the intended transport borings.

### Start-up , operation



#### **WARNING!**

#### **Risk of injury due to improper start-up and operation**

Improper start-up and operation can lead to serious bodily injuries or property damage. Therefore:

- Have all work during initial operation exclusively performed by the manufacturer's employees or by his authorised representatives or by trained personnel.
- Start-up and operation may only be performed by adequately qualified personnel that has been authorised and instructed by the operator.
- Before the start of any work, ensure that all covers and protective devices are correctly installed and function correctly.
- Never override any protective equipment during operation.
- Pay attention to tidiness and cleanliness in the working area! Loosely stacked or scattered components and tools are accident sources.



## Maintenance and trouble shooting



### **WARNING!**

#### **Risk of injury due to improper maintenance and trouble shooting!**

Improper maintenance and trouble shooting can lead to serious bodily injuries or property damage. Therefore:

- Maintenance work and trouble shooting work may only be carried out by adequately qualified and instructed personnel.
- Secure machine against restarting, switch off drives!
- Before starting any work, provide for sufficient space and freedom of movement during assembly.
- Pay attention to tidiness and cleanliness in the assembly area! Loosely stacked or scattered components and tools are accident sources.

If components must be replaced:

- Pay attention to correct installation of spare parts.
- Properly reassemble all fastening elements.
- Observe screw tightening torques.
- Before restarting, ensure that all covers and protective devices are correctly installed and function correctly.
- After completion of maintenance work and trouble shooting, check correct functioning of safety equipment.



### 3.2 Dimensions RPO 800

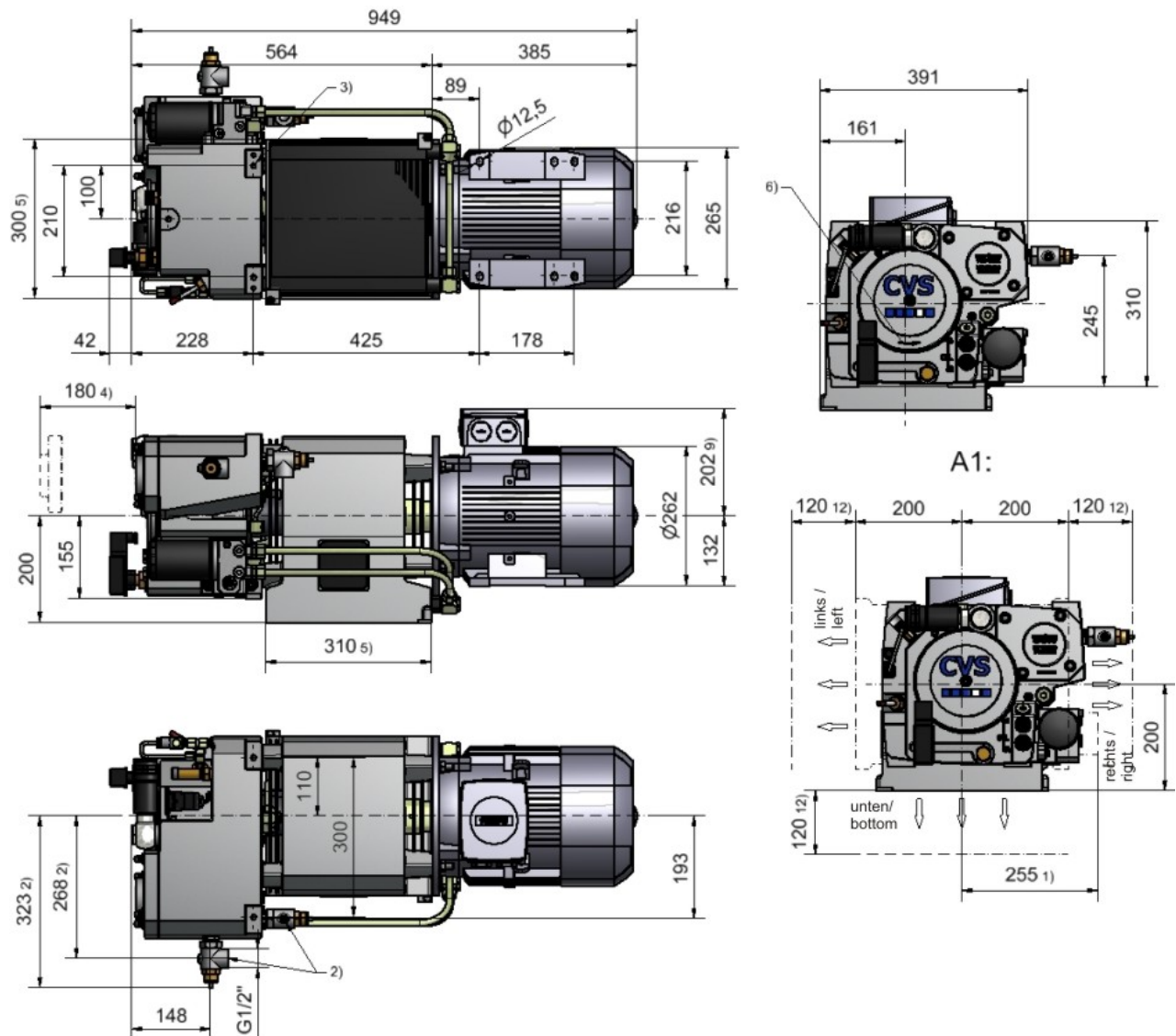


Fig. 2: Dimensions RPO 800

A1: Illustration of the possible blowout directions of the oil cooler

- |   |  |    |   |
|---|--|----|---|
| 1 | Line to the oil cooler with blow out direction "right"   | 8  | —   |
| 2 | Compressed air either "to the side" or "to the rear". With the blow out direction "to the right", only ""to the side" is possible.       | 9  | Terminal box for the motor is on top (standard). As agreed, right and left are also possible. |
| 3 | Attachment borings M12 x 26. Required min. screw-in depth: 24 mm.  | 10 | From 01.01.2013, 1LE1 motors will be employed.  |
| 4 | Clearance for filter change (Oil separator, air filter, oil filter)  | 11 | Total weight with 1LE1 motor  |
| 5 | Interior diameter for vent channel at the transition point. Expand the vent channel to keep the accumulated pressure as low as possible. | 12 | Minimum distance to the wall  |
| 6 | Sense of rotation viewing the "maintenance side of the compressor" or "the motor drive shaft": left.                                     |    |   |
| 7 | Weight specification: compressor unit without oil filling  |    |   |

## Technical data

### 3.3 Technical data

Description	Unit	RPO 200	RPO 300	RPO 400	RPO 600	RPO 800
Suction volume flow <sup>1), 2)</sup>	[l/min]	180/175	260/256	380/375	550/540	770/758
Final overpressure <sup>3)</sup>	[bar <sub>g</sub> ]	10/12				
Suction pressure	[mbar]	1000				
Motor rated speed	[min <sup>-1</sup> ]	1420	1420	1440	1455	1455
Power requirement at the shaft <sup>2)</sup>	[kW]	2,1/2,3	2,7/3,0	3,8/4,2	5,2/5,7	7,2/7,9
Final overpressure range	[bar <sub>g</sub> ]	3...10/12				
Speed range	[min <sup>-1</sup> ]	1000...2200	1000...2200	1000...2200	1000...2200	1000...2200
Sound pressure level <sup>4)</sup>	[dB(A)]	63	63	64	64	65
Oil content <sup>5)</sup>	[l]	1.8 / 2.4	1.8 / 2.4	1.8 / 2.4	2 / 2.6	2 / 3
Remaining oil content of the compressed air <sup>6)</sup>	[mg/m <sup>3</sup> ]	< 5				
Voltage of electric motor	[V AC]	3 x 400				
Frequency of electric motor	[Hz]	50				
Protection class of electric motor	–	IP 55 (shakeproof)				
Design of electric motor	–	B35				
Weight without drive motor <sup>7)</sup>	[kg]	57	56	56	54	55
Weight with drive motor <sup>7)</sup>	[kg]	78	80	87	95	104
Cooling suction temperature <sup>8)</sup>	[°C]	–40...+40				

1) Suctioned volume flow referenced to 20 °C, acceptance as per DIN ISO 1945/ISO 1217

2) with final overpressure 10 bar<sub>g</sub> / 12 bar<sub>g</sub>

3) positive working pressure > 10 bar<sub>g</sub> only in connection with idle control to avoid the generation of condensate

4) sound pressure level as per DIN 45635 with a compressor speed of 1500 min<sup>-1</sup>, open air measurement: 7 m, driven via AC motor and a positive working pressure of 10 bar<sub>g</sub>. When driven by a DC motor or converter driven AC motor, the sound pressure level can be above the indicated values.

5) higher value: oil volume during first fill. lower value: oil volume that can be drained and refilled during an oil filter change. The difference is the remaining residual oil in the compressor.

6) with static operation; With pulsations, such as caused by the compressed air dryer, a pulsation damping valve must be installed, see page 43.

7) compressor without fill

8) for higher temperatures, please consult with CVS engineering GmbH

Table 1: Technical data

## Technical data

<b>Type key</b>	RPO	400	LA	LLA
Rotation compressor with oil cooling				
Suction power of the compressor, approx.	e.g. 400 ~ 400 l/min			
Load intermittent duty				
Load idle intermittent duty				

### Lubricating oils

Only mineral oils or synthetic oils with the following specifications or proven same-grade oils are permitted for operating the RPO compressor:

Specification	Value
API	CD/SF or higher
MIL	L2104 C or higher

### Mineral oils

Brand	Designation up until 2002	Designation as of 2002
ARAL	Multi Turboral SAE 15W-40	
BP	Vanellus FE 10W-40	Vanellus C6 Global Plus 10W-40
DEA	Cronos Super DX SAE 15W-40	
ELF	Ecomax FE PLUS 10W-40	Ecomax FE 10W-40
ESSO	Essolube XT-201 SAE 15W-40	
MOBIL	Delvac 1400 Super 15W-40	Delvac MX 15W-40 Devlac MX Extra 10W-40
SHELL	Myrina TX 10W-30	Rimula Ultra 10W-40

Tab. 2: Mineral oils

### Synthetic oils

Brand	Designation
ALUCHEM	Alusynt RRC SAE 5W-40 Alusynt C 57 T-DE
MOBIL	Delvac 1 SAE 5W-40
ANDEROL	3057 M

Tab. 3: Synthetic oils

### Synthetic oil at deep temperatures



#### CAUTION!

Use synthetic oil if the ambient temperature is -40 to -25°C.

## Technical data

### 3.4 Rating plate

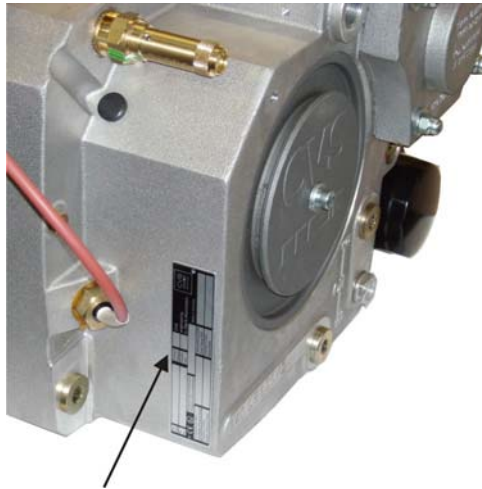
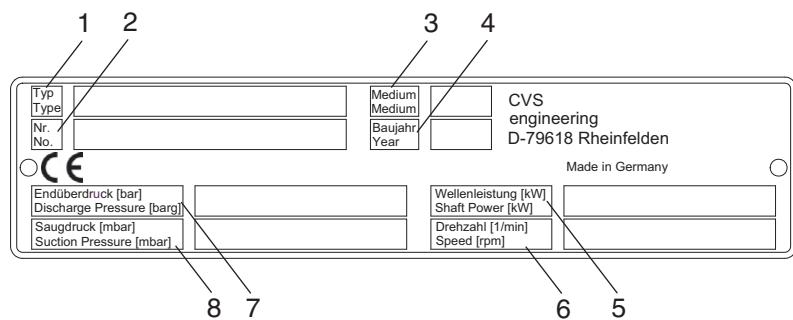


Fig. 3: Location of the rating plate



1 Typ Type	2 Nr. No.	3 Medium Medium	4 Baujahr Year	CVS engineering D-79618 Rheinfelden
CE				Made in Germany
Endüberdruck [bar] Discharge Pressure [barg]		Wellenleistung [kW] Shaft Power [kW]		
Saugdruck [mbar] Suction Pressure [mbar]		Drehzahl [1/min] Speed [rpm]		
8		7		
		6		
		5		

Fig. 4: Rating plate

- 1 Model
- 2 Serial number
- 3 Medium
- 4 Year built
- 5 Shaft power in kW
- 6 Speed in 1/min
- 7 Final overpressure in bar
- 8 Suction pressure in mbar



## 4 Design and function of compressed air system

### 4.1 Design

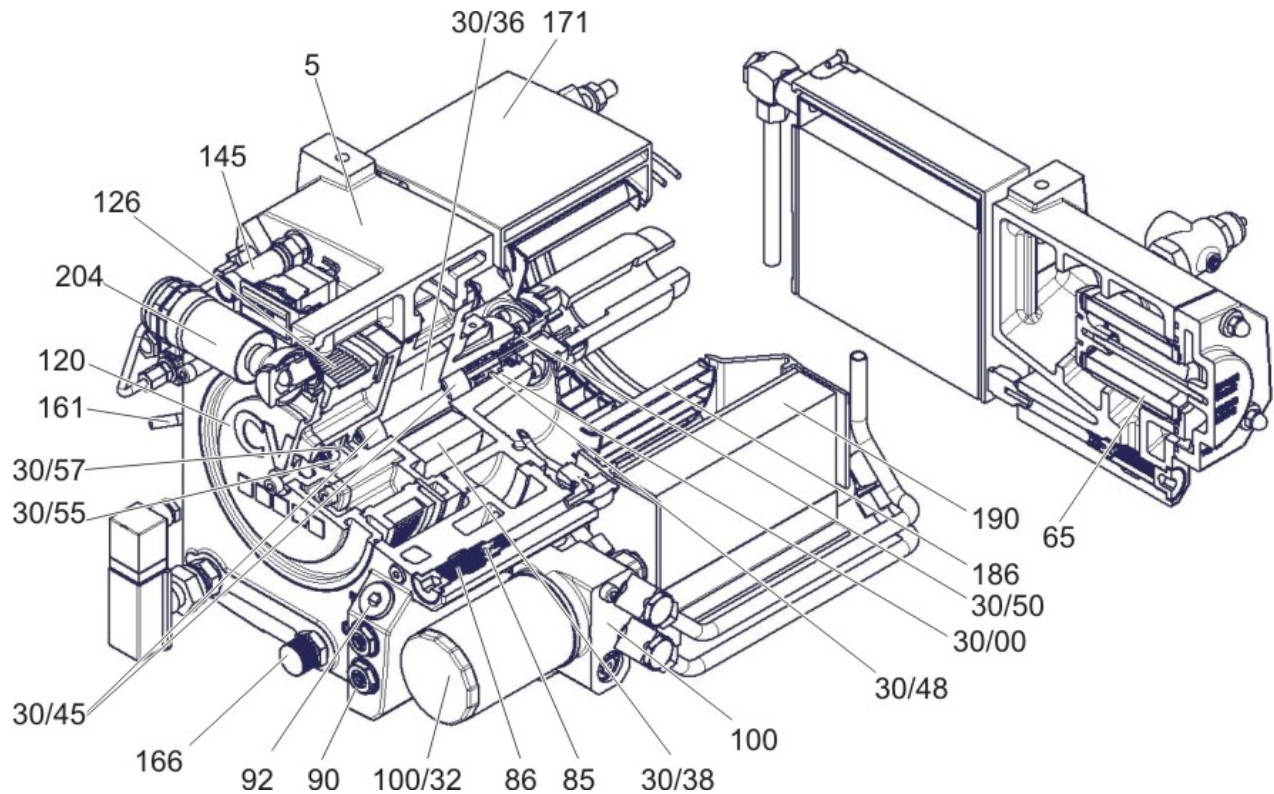


Fig. 5: Design of RPO compressor

5	Casing compressor	145	Safety valve	30/38	Rotor vane
65	Oil separator	161	Temperature safety switch	30/45	Needle bearing
85	Nozzle with RV oil suction	166	Oil drain valve	30/48	Slide ring seal
86	Sieve of suction	171	Intermediate flange	30/50	Radial shaft seal
90	Oil sight glass	186	Fan with coupling	30/55	Piston for suction regulator
92	Oil fill screw	190	Oil cooler	30/57	Non-return valve with suction regulator
100	Thermostat, complete	204	Air suction cyclone	100/32	Oil filter
126	Air filter	30/00	Step, complete		
120	Air filter cover	30/36	Rotor		

## Design and function of compressed air system

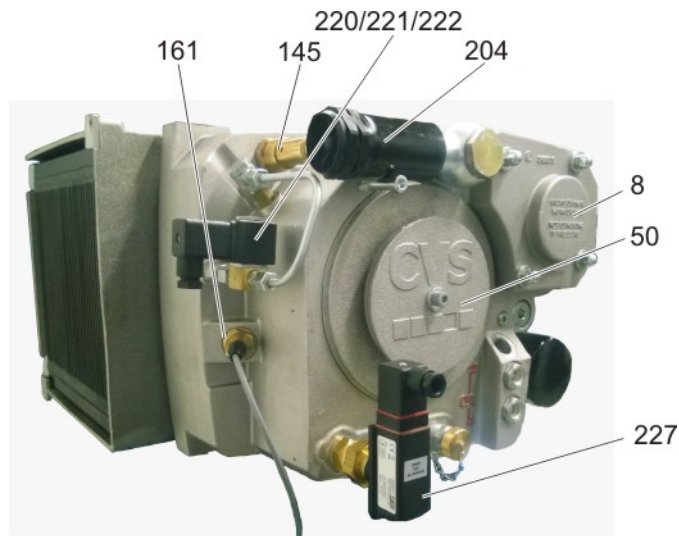


Fig. 6: Maintenance and safety equipment of the RPO compressor

8	Oil separator cover
50	Casing cover
145	Safety valve
161	Temperature safety switch 110 °C
204	Air suction cyclone
220/221/222	Load idle valve with coil and plug
227	Oil level monitor

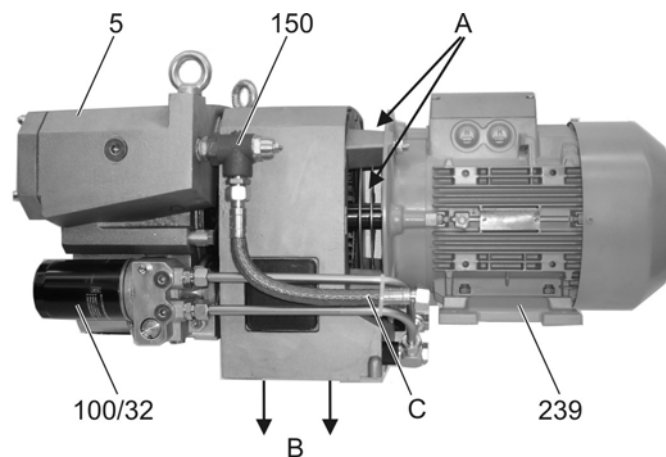


Fig. 7: Cooling air

5	Compressor casing
150	Minimum pressure non-return valve
100/32	Oil filter
239	Electric motor
A	Cooling air suction
B	Cooling air exit
C	Hose (not part of the delivery scope of CVS engineering)



## Design and function of compressed air system

### 4.2 Function

#### General

CVS rotational compressors with oil injection cooling of the model series RPO are compact one-step compressors, ready to install and constructed as per the European standard EN 1012-1 for the compression of atmospheric air, designed for positive overpressures of 10/12 bar<sub>g</sub>.

The back cooling of the injected oil is performed by an air-cooled heat exchanger.

The compressor delivers low-pulsation compressed air with an exit temperature of approx. 70 °C.

The compressors are available in two operation modes:

- Load intermittent duty (LA)
- Load idle intermittent duty (LLA)  
(Positive working pressure > 10 bar<sub>g</sub>  
only in connection with idle control)

#### Air passage

The air is suctioned via the air suction cyclone (204) and reaches the suction regulator (30/55), (30/57) via the air filter (126); from there, it travels axially into the compressor step (30/00).

In the compressor step, the air is compressed. At the same time, oil is injected to cool and lubricate. The compressed air leaves the compressor step and enters the preseparation chamber, where the majority of the oil is separated from it. After that, it is transported on to the oil separator (65). This reduces the residual oil content of the compressed air to less than 5 mg/m<sup>3</sup>. The compressed air leaves the compressor via the combined minimum pressure non-return valve (150).

The safety valve (145) protects from overpressure

#### Oil circuit

A thermostat (100) is installed in the oil circuit to regulate the temperature.

With an oil temperature of > 75 °C, the oil is routed via an oil cooler and returned to the compressor step via the oil filter.

In the compressor step, the oil is mixed with the air to be compressed, while it picks up the compression and the friction heat and prevents backflow losses.

The oil is separated from the compressed air in the preseparator chamber and in the oil separator and returned to the process once again.

## Design and function of compressed air system

### Functional principle of the compressor step

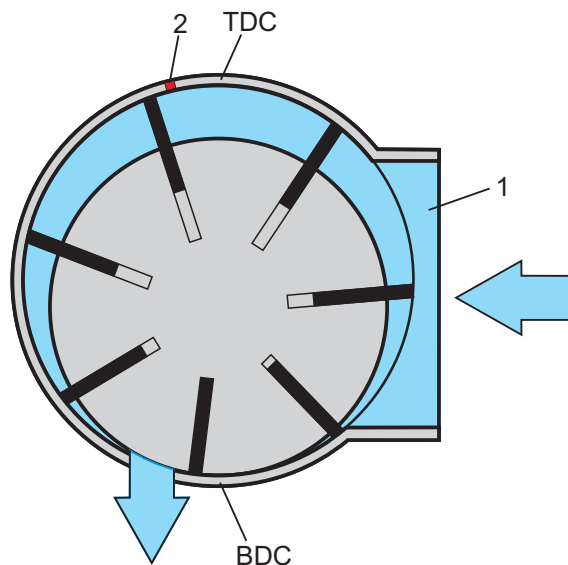


Fig. 8: Principle diagram of compressor step

- 1 inlet channel
- 2 oil injection
- TDC top dead centre
- BDC bottom dead centre

The air reaches the compressor step via the inlet channel (1). The suctioning cell is closed by the subsequent vane approx. at top dead centre (TDC), once it has reached its maximum volume. When you continue to rotate the rotor, the cell's volume will be decreased and this will make the air denser. Shortly before reaching the bottom dead centre (BDC), the densified air will be expelled.

During the densifying process, oil is sprayed into decreasing cells via nozzles (2), which pick up compression and friction heat and prevents return flow losses.

## 4.3 Components

### 4.3.1 Air filter (Fig. 5: 126)

The air filter cleans the air suctioned by the compressor.

### 4.3.2 Oil filter (Fig. 5: 100/32)

The oil filter cleans the circulating oil.

## Design and function of compressed air system

### 4.3.3 Minimum pressure and non-return valve (Fig. 7:150)

The combined minimum pressure and non-return valve at the compressed air output is designed or adjusted so that air only can flow into the connected pressure line if there is an operation overpressure of approx. 2 bar<sub>g</sub>. This will ensure the oil circulation in the machine, even if the pressure in the consumer line is only built up very slowly or if it falls below approx. 2 bar<sub>g</sub> in case of large volumes used.

### 4.3.4 Electric motor (Fig. 7: 239)

The electric motor must be connected to the compressor step (30/00) via a form-locking rotational elastic coupling. The drive can also be driven by a V-belt and the belt pulley.

Depending on the model, the electric motor is switched either directly or via the star triangle switch. The shut off or switch on of the motor depends on the respective use/consumption of the compressed air.

### 4.4 Oil cooler (Fig. 5: 190)

The oil cooler is an air-cooled heat exchanger, in which the circulating oil is cooled back by the compressor step.

### 4.5 Thermostat (Fig. 5: 100)

In order to avoid condensate failure during operation in the compressor casing, the compressor's final temperature is regulated by a thermostat that is built into the oil circuit.

When the oil temperature reaches 75°C or more, it is routed through the oil cooler.

### 4.6 Safety and shutoff functions

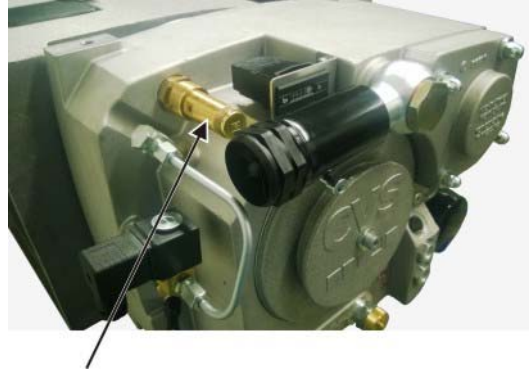
The compressor is equipped with the following safety and shutoff functions:

- Safety valve: blows off when the set overpressure is exceeded and thus protects the components from overpressure
- Temperature safety switch: switches the compressor off if the temperature exceeds 110°C
- Cold conductor sensor on electric motor: switches off the electric motor when the coil is overheated

## Design and function of compressed air system

### 4.6.1 Safety valve (Item 145)

To safeguard against exceeding the max. permissible operation overpressure, a safety valve has been installed as per EN 1012-1.



*Fig. 9: safety valve*

### 4.6.2 Temperature safety switch (Item 161)

As per EN 1012 part 1 § 5.5.3.2, the final compression temperature in the outlet must not exceed 110°C under normal circumstances.

The compressors are equipped with a temperature safety switch that will switch off the compressor if the temperature exceeds 110°C.



*Fig. 10: Temperature safety switch*

## Design and function of compressed air system

### 4.7 Options

#### 4.7.1 Sound proof hood

To further lower the sound pressure level, the compressor can be equipped with a sound proof hood.  
You can also use a customer supplied sound proof hood.



Fig. 11: Example CVS compressed air system with sound proof hood (closed and open)

#### 4.7.2 Oil level monitor (227)

The optional oil level monitor can be connected either to the closer or opener.

By connecting suitable warning devices (alarm signal, warning lamp), the oil level monitoring becomes more comfortable with compressor units installed inside vehicles.

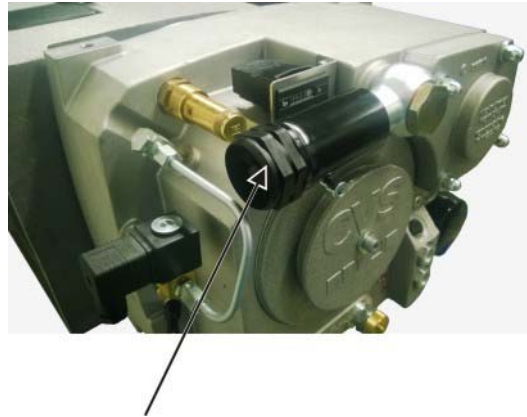


Fig. 12 : Oil level monitor

## Design and function of compressed air system

### 4.7.3 Air suction cyclone (204)

The optional air suction cyclone is used to prefilter the suctioned air.



*Fig. 13: Air suction cyclone*

### 4.7.4 Compressed air dryer

To dry the fed compressed air, you can connect a compressed air dryer.

The downstream compressed air dryer can cause system-related pulsations in the pressure line. In this case, a pulsation damping valve must be installed downstream from the compressor.

Additionally, the dryer function (switching) can be monitored.



*Fig. 14: Example compressed air dryer and pulsation damping valve*

- 1 Adsorption dryer
- 2 Pulsation damping valve

#### **4.7.5 Oil temperature monitoring**

For temperature monitoring, the safety temperature switch can be additionally equipped with a resistance thermometer (PT 100) (optional).

The measured resistance must be converted to the desired analogue signal by the customer<sup>1)</sup> using a temperature converter.

<sup>1)</sup> For complete compressed air systems, the temperature converter can be integrated in the compressor management.

## Transport and storage

# 5 Transport and storage

## 5.1 Safety notes for transport

Refer to chapter 2.5 Safety!

**Personal protective equipment**

See Chapter 2.4.

## 5.2 Transport

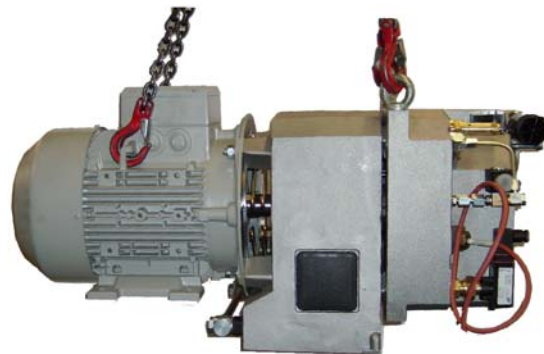
The compressor, which is fastened on a base plate, must be transported either by crane or a fork lift. The lifting gear must be designed for the weight of the compressor. → Weight see page 20, Chapter 3.3.

### For future transports:

- Seal all open connections with protective caps (prevents penetration of dirt and water)
- Drain the compressor oil
- Securely fasten the compressor prior to transport (e.g. screw it onto a pallet)
- Transport and put down the compressor with a fork lift or secure with straps and lift with suitable lifting gear.

**Transport by crane**

Attach the compressor to the appropriate transport borings.



*Fig. 15: Transport by crane*



## 5.3 Storage

### Storage of packages

In order to protect the compressor from damages during sea transport or in case of extended storage, it is sealed in protective film. Compressor parts that are not painted or galvanised are treated with preserving oils at CVS.

Store packages under the following conditions:

- Do not store outdoors.
- Store dry and dust free.
- Do not expose to aggressive media.
- Protect against solar irradiation.
- Avoid mechanical vibrations.
- Storage temperature:  $-10$  to  $+60$  °C
- Relative humidity: max. 95%, non-condensing
- If storage lasts longer than 3 months, regularly check the general condition of all parts and of the packaging.
- Do not remove the protective film until shortly prior to installation.
- Do not remove the covers on the suction and outlet until directly before the final installation.
- If the compressor is to be stored for more than 6 months, please consult CVS Engineering.

## Installation and assembly

# 6 Installation and assembly

## 6.1 Safety during installation and assembly

Refer to chapter 2.5 Safety!

Personal protective equipment

See Chapter 2.4.

## 6.2 Installation diagram

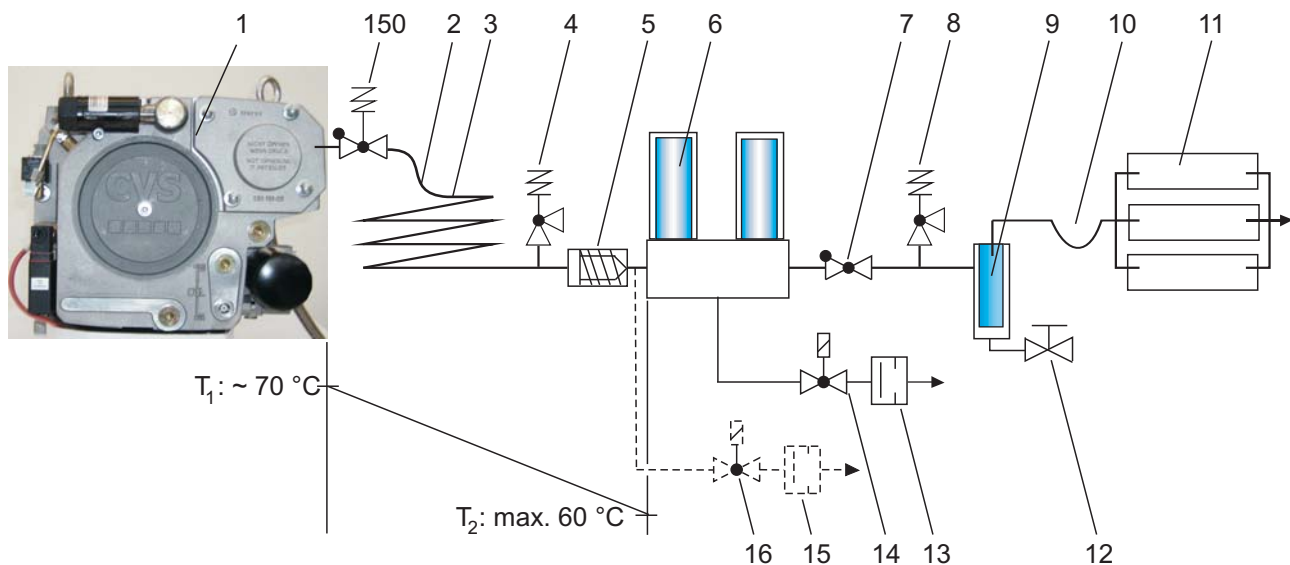


Fig. 16: Installation diagram

1 Compressor <sup>2)</sup>	9 Fine filter (only required with compressed air quality: < 5 mg/m <sup>3</sup> residual oil content)	150 Minimum pressure/non-return valve
2 Compensator and hose line	10 Compensator (hose line)	15 Muffler
3 Compressed air after cooler (cooling coil) <sup>3)</sup>	11 Compressed air reservoir	16 Relief valve
4 Safety valve	12 Manual emptying	Pos. 15 and Pos. 16 only required if Pos. 6 is not available with Pos. 14
5 Pulsation damping valve	13 Muffler	
6 Compressed air dryer	14 Drainage valve of dryer	
7 Non-return valve		
8 Safety valve		
		T1: Output temperature compressed air
		T2: Input temperature compressed air dryer

1) The compressed air line between the compressor and the input of the compressed air dryer must be connected downhill to the compressed air dryer.

2) The temperature in the installation room must not exceed 40°C.

3) The length of the cooling coil is to be selected so that the input temperature into the compressed air dryer does not exceed 60°C.

## 6.3 Installing the compressor



### CAUTION!

CVS engineering recommends having the installation performed and checked by CVS engineering.

**Positive working pressure  
> 10 bar<sub>g</sub>**



### CAUTION!

With positive working pressures of more than 10 bar, the compressor should be operated in the load idle intermittent duty.

**Avoiding storage damage**



### CAUTION!

The compressor must be attached to the vehicle frame using rubber elastic bearings. A non-observance can lead to storage damage on the compressor and the electric motor.



### NOTE!

*CVS engineering would gladly assist you with the selection of a suitable installation location in the vehicle.*

The machine is attached to the compressor and the electric motor via 2 attachment locations each.

**Attachment requirements**

- The attachment points on the vehicle must feature a sufficient load capacity and rigidity.
- The attachment points must be on the same level.
- The fastening screws must feature a sufficient clamping length.

**Installation location requirements**

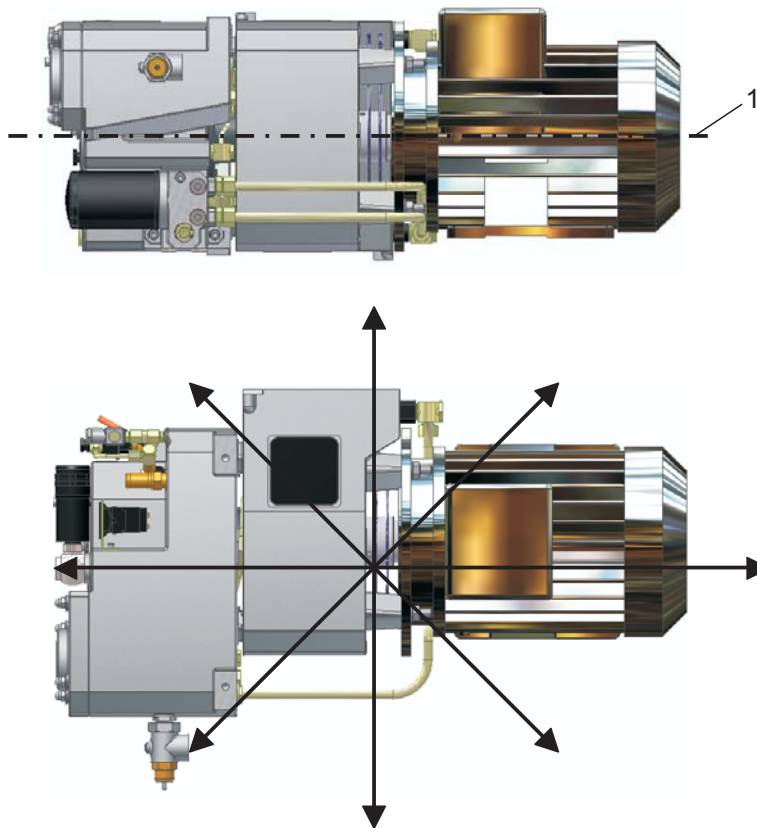
The installation location must fulfill the following requirements:

- protect from dirt, falling rocks and spray water.
- no exposure to direct drive wind.
- protect the drive motor of the compressor from direct sunlight, e.g. by attaching sheet metal paneling.
- offer sufficient space for accidental contact protection.
- offer sufficient space for the connections of the suction and pressure lines.
- ensure good legibility of the instruments.
- be accessible for maintenance and repair work, e.g. for air and oil filter changes or the control of the safety and non-return valve on the service side of the compressor. Also see page 18 ff, Fig. 1 and Fig. 2.

## Installation and assembly

### Installation position

The installation position of the compressor can be selected freely in reference to the driving direction if the machine axle is horizontal.



*Fig. 17: freely selectable installation position with horizontal machine axle*

1 Horizontal machine axle

In the longitudinal and the cross axle, the deviation from the horizontal machine axis may not exceed 12° or 21%.

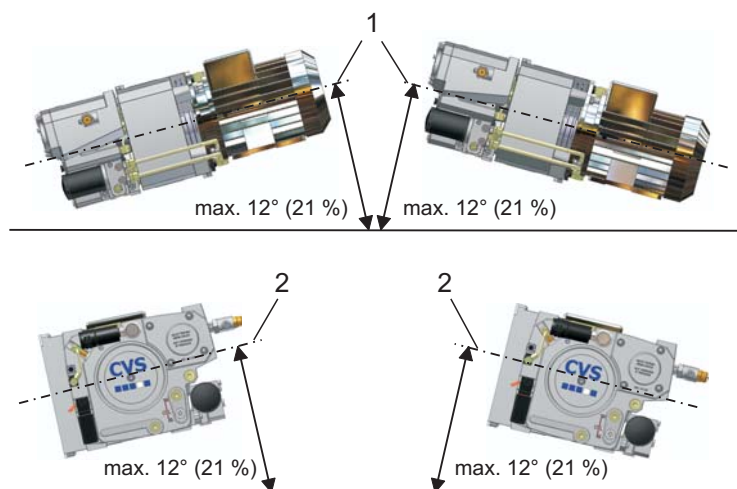


Fig. 18: top: max. deviation of longitudinal axle  
bottom: max. deviation of cross axle

- 1 Longitudinal axle
- 2 Cross axle

## Assembly

- 1 Use the suitable transport means to place the compressor into the intended installation position on the vehicle. Observe transport instructions in Chapter 5.
- 2 Attach the machine with screws as per Table 4 without tension.

Use the following screws to attach the compressor:

Screw	Solidity	Torque	Screw-in depth in the compressor casing
M12	8.8	80 Nm	24 mm

Table 4: Fastening screws

The fastening screws for the electric motor must match the attachment borings.

## Installation and assembly

### 6.4 Drive



#### CAUTION!

- If the drive motor is installed at a later time, the selection and layout lie in the responsibility of the system designer.
- Do not route axial forces into the compressor shaft when installing drive components.
- Do not tap couplings or other connection components onto the shaft, but slide them on.
- Check the torque and the sense of rotation.

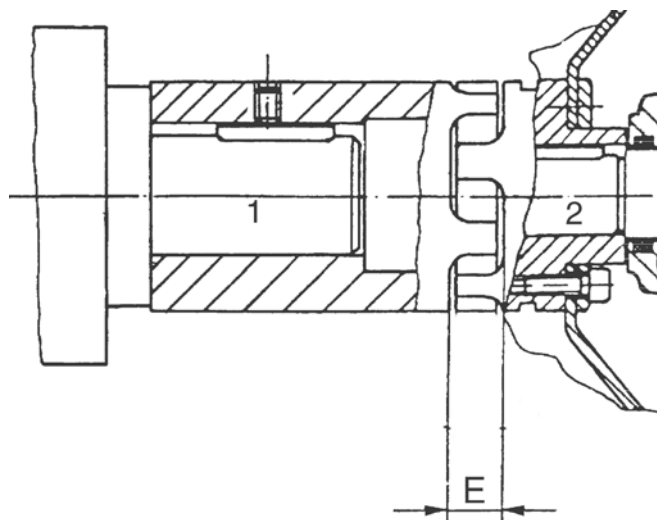


Fig. 19: Coupling play

- 1 Motor side
- 2 Compressor side
- E 20 mm

#### 6.4.1 V belt drive



#### CAUTION!

- Only install the V belt drive with additional exterior bearing of the drive shaft. The drive shaft is not designed for cross force by the belt pre-tension.
- Observe the design, installation and inspection instructions of the manufacturer.

## Assembly

- Carefully and correctly align the axles of the driving and driven shaft on all levels.
- Align the V belt pulleys accurately.
- Select the V belt by length for an even belt tension.
- Smallest permissible effective diameter of the pulleys = 140 mm.

## 6.5 Oil cooler

The oil routed to the compressor is back cooled via a heat exchanger. The following table lists the volume flow of the cooling air for the compressor:

Description		Unit	RPO 200	RPO 300	RPO 400	RPO 600	RPO 800
Positive working pressure <sup>1)</sup>		[bar <sub>g</sub> ]	10/12	10/12	10/12	10/12	10/12
Oil cooler (Pos. 190)	Cooling air volume flow	[m <sup>3</sup> /h]	400	500	600	800	1100
	max. cooling air suction temperature <sup>2)</sup>	[°C]	40				
External oil cooler	Cooling air volume flow	[m <sup>3</sup> /h]	700	700	700	700	950
	max. cooling air suction temperature	[°C]	55	55	52	50	50

1) with a compressor speed of 1,500 min<sup>-1</sup>

2) Temperature of the air suctioned by the cooling fan, for higher temperatures please consult CVS engineering

Table 5: Oil cooler specifications

### Installing the external oil cooler

Please observe the following when installing an external oil cooler:

- Max. line length between the cooler and the compressor: approx. 1 m.  
for longer line lengths, please consult CVS engineering
- Do not exceed the max. cooling air suction temperature (temperature in the installation room of the external oil cooler) indicated in "Table 5".
- The oil must flow through the cooler from the bottom up.
- If the oil cooler is installed below the compressor, an oil drain stopcock must be installed on the oil cooler or the connection line at the lowest point.

## Installation and assembly

### 6.5.1 Cooling oil hoses

#### Leaks



#### CAUTION!

When screwing the oil output and input lines into the cooler, support the torque on the edge of the bushing. If this is not observed, there can be leaks on the bushing soldering spot.

#### Cooling oil hoses

The cooling oil hoses must meet the following requirements:

- Core made of Teflon or Viton
- DIN 20024
- Interior pipe diameter as per the following table:

Compressor	Interior pipe diameter [mm]
RPO 200/300/400/600	9
RPO 800	12

Table 6: Interior pipe diameter of the cooling oil hoses

You can also purchase the cooling oil hoses from CVS engineering.

### 6.6 Line connection (pressure line)

#### Condensate



#### CAUTION!

In order to prevent condensate from entering the compressor, route the pressure line from the compressor **in a declining** fashion. Condensate that leaks into the compressor can cause damage to it.

#### Pressure line

The pressure line must fulfill the following requirements:

- corrosion-proof
- Interior pipe diameter as per the following table:

compressor	Interior pipe diameter [mm]
RPO 200/300/400/600	12
RPO 800	15

Table 7: Interior pipe diameter of the pressure line



## Assembly

Install the line as follows:

- Route the pressure lines declining from the compressor.
- Install a compensator (such as a pressure hose) between the compressor and the site's compressed air supply.  
Recommended pressure hose: PTFE corrugated hose with stainless steel fixtures

## 6.7 Air suction cyclone

By standard, the air suction cyclone is screwed directly to the suction opening of the compressor.

### Notes for offset air suction cyclone

If the cyclone separator is installed offset and is connected to the compressor via a vacuum hose (i.e. if there is a risk of suctioning water), the following guidelines must be observed during installation:

- Horizontal placement of the cyclone separator
- Dirt disposal slot must always point down
- Min. interior diameter of the vacuum hose: 30 mm

## 6.8 Relief valve

If the devices that are installed downstream from the compressor are not equipped with relief possibility, a relief valve must be installed on the vehicle between the compressor and the non-return valve on the compressed air reservoir input.

When the compressor is shut off, the relief valve opens and the pressure volume between the compressor and the compressed air reservoir is relieved slowly (approx. 5...10 seconds).

If there is a compressed air dryer installed downstream from the compressor, which relieves pressure after a shutoff, no external relief equipment is necessary. A pulsation valve is to be installed upstream of the compressed air dryer, which slowly relieves compressed air from the system. Also see Page 34, Fig. 16.

When restarting the compressor against the relieved pressure line, the required startup power of the electric motor is lower, which avoids an excessive heatup of the electric motor winding with frequent start and stop cycles.

The pressure in the compressor in front of the minimum pressure valve is still at approx. 2 bar<sub>g</sub> after the line network has been released.

## Installation and assembly

### 6.9 Safety equipment and control elements

To protect from unauthorised excession of the permitted positive working pressure, safety valves must be installed at the site. Install the safety valves in the locations, where the line networks are separated (e.g. back flap).

The site must provide suitable control elements such as pressure monitors to switch the compressor on and off according to the pressure.

#### 6.9.1 Safety valve (on site)

The safety valves prevent the excession of the permissible max. pressure.

##### Risk of explosions



##### **DANGER!**

##### **Risk of injury by explosions!**

Explosions can cause severe injuries!

Therefore:

- Install the safety valve as instructed. Observe the manufacturer's instructions.
- Only use the safety valve for its intended purpose.
- Never block the safety valve.

#### 6.9.2 Pressure monitor (on site)

The pressure monitor is used to control the compressor. For this, the pressure provided by the network (pressure after dryer) is probed and compared to the minimum and maximum pressures set on the pressure monitor. The pressure monitor emits an electrical signal to the control, which shuts the compressor off or switches it on.

Further information is contained in the operating instructions of the pressure monitor.

#### 6.10 Oil level monitor (optional)

The oil level monitor can be connected either to the closer or opener.

Further information is contained in the operating instructions of the level monitor.

#### 6.11 Cyclone separator or fine filter

To further improve the quality of the compressed air, an additional cyclone separator or a fine filter can be installed downstream.

## 6.12 Pulsations (pulsation damping valve)

If there are devices installed downstream of the compressor, which cause sudden pulsations (pressure break-ins, such as adsorption dryers), a pulsation damping valve must be installed downstream of the compressor.

### Pulsations of downstream devices



#### **CAUTION!**

Pulsations cause malfunctions in the compressor.

## 6.13 Sound proof hood



#### **NOTE!**

*Please consult CVS engineering if you decide to install a sound proof hood afterwards.*

### Notes

Observe the following during installation:

- A sufficient cooling air volume to reroute the heat volumes, also from the additional units, must be ensured.
- The separation of input and output air must be effective.
- Install an additional oil cooler if needed.

## 6.14 Electrical connection

### Electrical mains connection

The compressor is prepared to be connected to the vehicle control at the factory.

When making the electric connection, observe the following:

- Check the supply voltage and the frequency.
- Route the cable without tension and friction points.
- Attach the cables every 300 mm.

After the installation, perform the sense of rotation check as per Chapter 7.2.2.

### Electric motor

The electric motor must be connected by the operator and regulated so that the permissible switch on frequency is not exceeded. See operating instructions for max. switch on frequency.

## Start-up and operation

# 7 Start-up and operation

## 7.1 Safety during start-up

Refer to chapter 2.5 Safety!

Personal protective equipment

See Chapter 2.4.

## 7.2 Start-up



### CAUTION!

The compressor is delivered without oil. Prior to startup, the compressor must be filled with oil.

### 7.2.1 Fill oil



### DANGER!

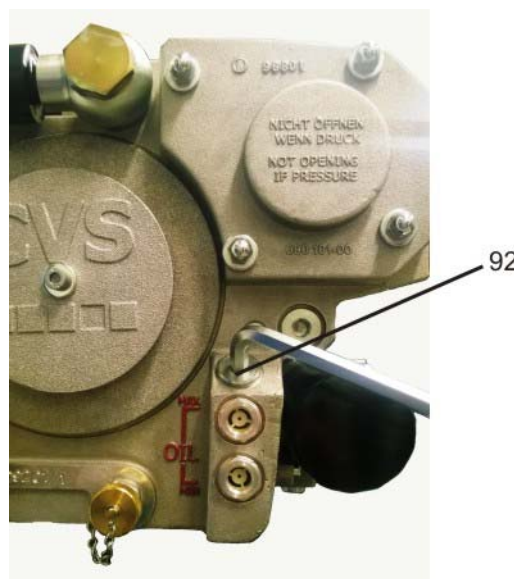
#### Danger due to improper operation!

- Only fill oil through the fill screw while the system is switched off and free of pressure.
- Protect the system from being restarted.

### Fill oil

Fill in the oil as follows. Oil volume and specification on page 20, Chapter "Specifications".

1. Ventilate the compressor casing via a safety valve (145). Completely relieve the overpressure. See Page 54, Chapter 8.5.
2. Open the oil fill screw (92) and add oil, e.g. through a funnel.





3. The required oil amount can only be filled by performing the procedure twice.  
During the first filling procedure, only fill the oil to the bottom edge of the fill opening (approx. 1.9 l).
4. Close the fill screw.
5. Close the safety valve.
6. Run the compressor for about 5 minutes to warm it up. The oil cooler and the oil filter is filled.
7. Switch off the compressor.
8. Ventilate the compressor casing via the safety valve.
9. Open the oil fill screw and fill in the required remaining volume (RPO 600 and RPO 800).
10. Close the safety valve and the oil fill screw.

## 7.2.2 Perform inspections

### Inspections prior to initial startup

The following points must be checked prior to initial start-up:

- Correctness of data on the rating plate
- Oil level as per page 52, Chapter 8.4)
- Sense of rotation of the compressor (see sense of rotation arrows, see Fig. 20).
- Correct connections of the compressed air lines (see Page 40, Chapter 6.6)
- Correct connections of the cooling oil lines (see Page 40, Chapter 6.5.1)
- Electrical connection (see Page 43, Chapter 6.14)
- Screw connections for tightness
- Correct adjustment of the vehicle side pressure monitor (see operating instructions "pressure monitor")

## Start-up and operation

### Sense of rotation

1. Briefly switch the drive motor of the compressor step on and off again. Check the sense of rotation on the coupling. Sense of rotation, viewed on the drive shaft of the electric motor: left. Repeated consecutive switching will lead to a thermal overload of the electric motor
2. If available, check the blower motor of the external oil cooler for the correct sense of rotation. The ventilator is switched on when the oil temperature reaches 75°C. The sense of rotation is correct, if the ventilator presses air through the oil cooler.



Fig. 20: Sense of rotation arrows

### 7.3 Switch on

Switch the compressor on as follows:

1. Open the shutoff devices (if available).
2. Start the compressor drive.
3. Check operating data.

### 7.4 Functional testing

Perform the following functional testing while the compressor is switched on:

- All connections are tight.
- Compression pressure has been reached
- Ventilator motor of the external cooling package switches at an oil temperature of approx. 75°C.

### 7.5 Switching off

Switch the compressor off as follows:

1. Switch off the compressor drive.
2. Close shut-off valves (if available)

## 7.6 Operation after long standstill or after extended storage



**NOTE!**

*After a long standstill or extended storage, CVS engineering recommends an inspection of the compressor by an authorised workshop.*

In case of a longer standstill or during extended storage (longer than 6 months)

- Perform an oil change prior to startup. The quality of the oil will decrease due to condensate buildup.
- Perform inspections as per Chapter.
- Perform functional testing as per Chapter.

## 7.7 Longer standstill



**NOTE!**

*Following a longer standstill of a compressor already built into the vehicle, CVS engineering recommends running the compressor every 6 weeks for about 30 minutes.*

## Start-up and operation

### 7.8 Operation

Positive working pressure  
> 10 bar<sub>g</sub>



#### CAUTION!

With positive working pressures of more than 10 bar, the compressor should be operated in the load idle intermittent duty.



#### CAUTION!

The setting of the opening pressure on the minimum pressure and non-return valve must not be altered.



#### NOTE!

*The optional oil cooler is equipped with a temperature-dependent cooling fan, which is switched on when the oil temperature reaches 75°C and switched off when it reaches approx. 70°C.*

*As the cooling fan switches dependent on the temperature, it can suddenly start while there is current applied, even if the compressor is not running.*

### 7.9 Operation modes



#### NOTE!

*The mains pressure is the pressure after the compressed air dryer.*



### 7.9.1 Load intermittent duty

During load intermittent duty, the compressor is automatically switched off by a pressure monitor after the desired mains pressure has been reached. At the same time, the non-return valve in the suction regulator (30/57) closes.

The line network is relieved by a site-supplied relief valve (see Chapter 6.8).

As soon as the network pressure falls below the minimum pressure set up in the pressure monitor, the compressor is switched on once again.

In this operating mode, you must ensure that the permissible switch on frequency of the drive motor is not exceeded.

- Switch on frequency for RPO 200 / 300 / 400: < 50/hour
- Switch on frequency for RPO 600 / 800: < 40/hour



#### **CAUTION!**

The operating temperature of the compressor should be between 75 and 90°C. During load intermittent duty, you must ensure that the switch on intervals are long enough.

If the operating temperature is not reached, there is a risk of condensate interruption in the compressor, which will then lead to a failure of the compressor.

### 7.9.2 Load idle intermittent duty

Compressors with load idle intermittent duty have an additional regulator valve (220), which distinguishes them from compressors with load intermittent duty

With this operating mode, the suction regulator (30/57) is closed once the desired network pressure is reached.

The compressor runs in idle mode, which will reduce the power consumption of the electric motor accordingly. If the pressure monitor does not signal another pressure loss after the time that was set on the time relay, the compressor is turned off completely electrically. But, if the demand is signalled by another pressure loss, the suction regulator will open and the compressor will enter the conveyor mode once again.

The pressure monitor and the time relay must be supplied by the customer.

## Maintenance

# 8 Maintenance

## 8.1 Safety during maintenance work

Refer to chapter 2.5 Safety!

### Personal protective equipment

See Chapter 2.4.

### Environmental protection

Observe the following information with regard to environmental protection during maintenance:

- Remove emerging, used or excessive grease at all lubricating points that are manually supplied with lubricant and dispose of in accordance with valid local regulations.
- Collect exchanged oil in suitable containers and dispose of in accordance with valid local regulations.

## 8.2 Cleaning



### **CAUTION!** **Machine damage possible!**

Aggressive cleaning agents and substances can damage or destroy electrical cables and adjacent components.

Therefore:

Do not use cleaning agents with aggressive ingredients.

- Remove the cleaning agent residue, specifically in the oil circuit.

### 8.3 Maintenance schedule

These maintenance procedures are required for an optimised and trouble-free operation. Maintenance intervals must be observed.

If increased wear of individual components or functional groups is determined during regular inspections, the operator has to reduce the required maintenance intervals on the basis of the actual signs of wear.

Changes compared to normal operation (increased power consumption, temperatures, vibrations, noises, etc. or response of monitoring systems) lead to the assumption that the functions are impaired. These then have to be subjected to an inspection by specialised staff.

In case of queries regarding the maintenance work and intervals: contact the manufacturer (service address → page 2).

Operating hour interval / years <sup>1)</sup>	Maintenance work	To be carried out by
1100 / 0.5	Visually check the oil level. <sup>2)</sup>	Operator
	Visually inspect the unit for leakage. <sup>2)</sup>	
	Check the air suction cyclone and clean if necessary. <sup>3)</sup>	
2200 / 1.0	Replace the air filter insert. <sup>3)</sup>	Specialist
	Oil change when using motor oil <sup>4), 5)</sup>	
	Replace the oil filter.	
	Replace air deoiler element.	
	Clean oil cooler (air side). <sup>2)</sup>	
4400 / 2.0	Minimum pressure non-return valve maintenance.	
8800 / 4.0	Check air suction regulator for leakage. Replace O-rings if necessary.	
	Replace suction nozzle with non-return valve.	
13000 / 6.0	Replace hoses.	
	Replace O-rings at the minimum pressure non-return valve.	
18000 / 8.2	Preventive repair of compressor step	CVS engineering or an authorised workshop
40000 / 18.3	Replace bearing on compressor and electric motor.	CVS engineering or an authorised workshop

1 Maintenance intervals "nominal": Whatever happens first; demand-dependent maintenance intervals, see operating instructions of the compressed air system for the designated project.

2 can be omitted if an oil level monitor is used

3 if used in heavily soiled conditions, this interval can be shorter. You may take suction air via a vacuum-tight hose line from the vehicle box.

4 After consulting CVS engineering and the oil manufacturer, the oil change intervals can be extended. However, you must have the oil inspected for this.

5 Interval can be doubled if using synthetic oil.

Table 8: Maintenance schedule

## Maintenance

### 8.4 Oil level check and oil change



#### CAUTION!

For a trouble-free operation, keep the oil change intervals and check the oil quality and the oil level. Here, observe the max. fill height (bottom edge of the oil fill neck thread).

Overfilling will lead to damages to the compressor.

#### 8.4.1 Oil level check

Visual check on oil level glass (90). The oil level must be above the top edge of the oil level glass.

The area between the top and bottom edges (see through) on the oil sight glass is the reserve area.

If the oil level is at the upper edge of the oil sight glass, the compressor can be run for another approx. 1,000 hours.

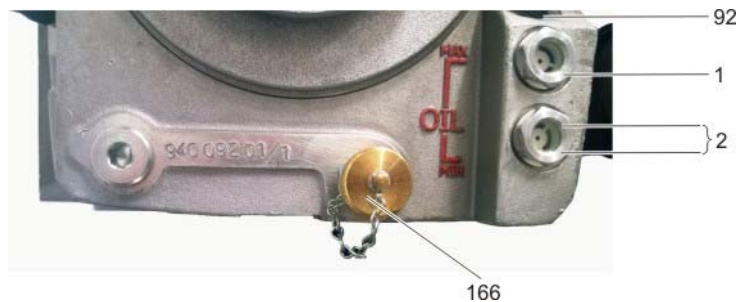


Abb. 21: Ölstandskontrolle

- |     |                  |
|-----|------------------|
| 1   | Max. fill height |
| 2   | Reserve area     |
| 92  | Oil fill screw   |
| 166 | Oil drain valve  |

## 8.4.2 Oil change



### CAUTION!

Perform the oil change with warm, switched off and pressure-free unit. The oil temperature should be 30...40°C.

### Oil level times

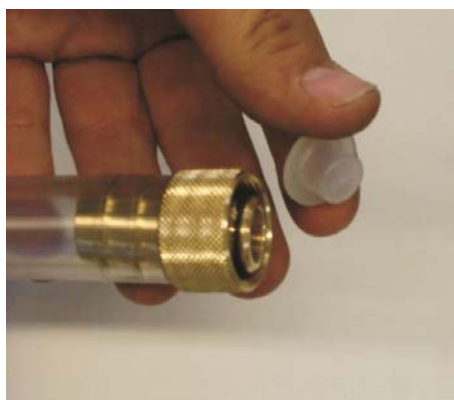
- The oil level time depends on the operating conditions and the compression final temperature. The oil level time is reduced after the compressor is not run within the limits indicated in the Chapter "Specifications".
- The oil level times can be significantly increased by contamination.
- CVS engineering recommends including the oil manufacturer in the oil test and to perhaps schedule new oil change intervals.

### Oil change

1. Ventilate the safety valve. See Page 54, Chapter 8.5.
2. Perform a pressure check on vehicle-side gauge.
3. Unfasten cover from the oil drain valve.

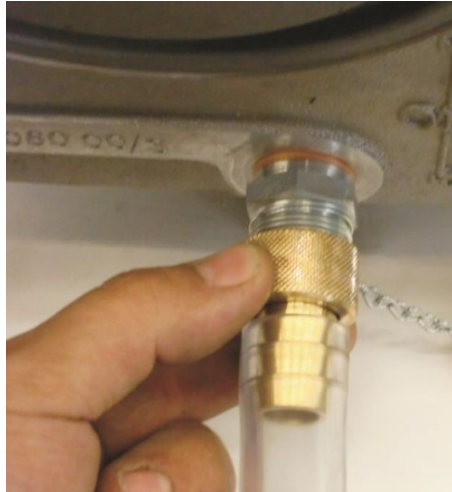


4. Remove plastic caps from the two ends of the drain hose.



## Maintenance

5. Screw drain hose onto the oil drain valve.



6. Drain oil into suitable container. Empty compressor completely.
7. Remove drain hose from the oil drain valve.
8. Push plastic caps into the two ends of the drain hose.
9. Screw cover onto the oil drain valve.
10. Dispose of waste oil in an environmentally safe manner.
11. Fill in oil. See page 44, chapter "Fill oil".

## 8.5 Safety valve on the compressor

### Risk of explosions



#### **DANGER!**

#### **Risk of injury by explosions!**

Explosions can cause severe injuries!

Therefore:

- Install the safety valve as instructed. Observe the manufacturer's instructions.
- Only use the safety valve for its intended purpose.
- Never block the safety valve.
- If the pressure exceeds the permissible value, immediately shut off the compressor.



#### **WARNING!**

#### **Danger of burns!**

The compressed air exiting from the safety valve contains oil and measures 80°C. It can cause most severe injuries.

Therefore:

- Only check the safety valve while wearing protective gloves and safety goggles.



***Wear hearing protection!***

*Wear hearing protection when venting the system and when performing a functional test of the lifting device.*

### **Ventilating the system/venting the safety valve**

Ventilate the system as follows:

1. Turn the cap on the safety valve all the way to the left.
2. Do not close the safety valve until no more compressed air is escaping.
3. Close the safety valve. For this, turn the cap on the safety valve all the way to the right.



*Fig. 22: Ventilating the safety valve*

### **Functional testing of the lifting device**

Perform a functional test in the following circumstances:

- during initial operation
- after interruption of the operation
- pursuant to the operating conditions and maintenance intervals to be specified by the operator (refer to TRB 600 and AD data sheet A 2)
- during the external or internal test of the respective pressure vessel.

The manufacturer of the safety valve recommends to perform an additional functional test once per month.

Perform the functional test pursuant to AD data sheet A 2 para. 4.7 and according to the following description:

1. Turn the lift button anti-clockwise until you distinctly hear that the operating medium is blown off.



***NOTE!***

*Do not unscrew the lift button too far out of the spring-center bolt.*

2. Turn the lift button clockwise as far as it will go.
3. Now, the safety valve is operative once more.

## Maintenance

### 8.6 Air suction cyclone (204)

If the compressor is equipped with an air suction cyclone, this must be tested and cleaned as per the maintenance table.

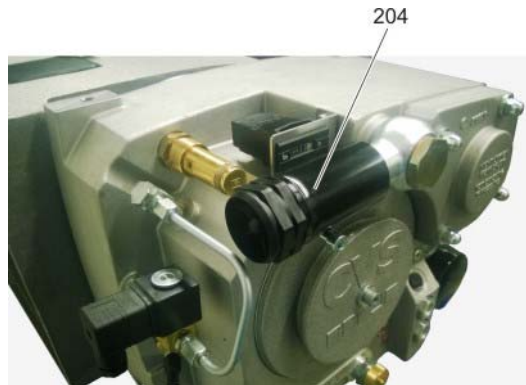
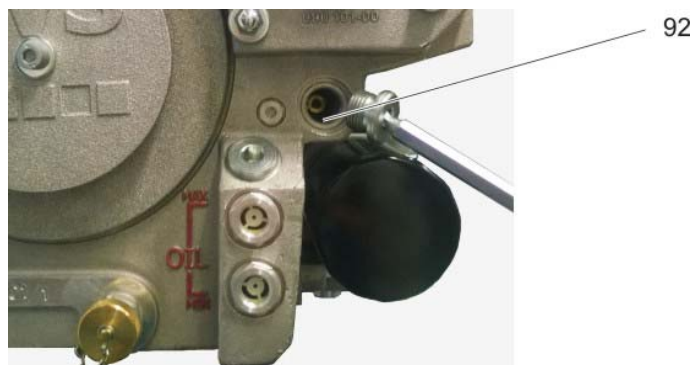


Fig. 23: Air suction cyclone

### 8.7 Cleaning the sieve insert (88) in the oil suction line

Clean the sieve insert in the oil suction line as follows:

1. Ventilate the safety valve. See Page 54, Chapter 8.5.
2. Unscrew the locking screw (92).



3. Take the sieve (88) out of the boring and clean with e.g. compressed air. Here, make sure that the nozzle boring of the non-return valve is not obstructed. (The non-return valve remains in the compressor casing.).





4. Insert the sieve.
5. Tighten the locking screw.

## 8.8 Air suction filter (126)

Clean or replace the air filter as follow:

1. Ventilate the safety valve. See Page 54, Chapter 8.5.
2. Unscrew the cylinder head screw (35).



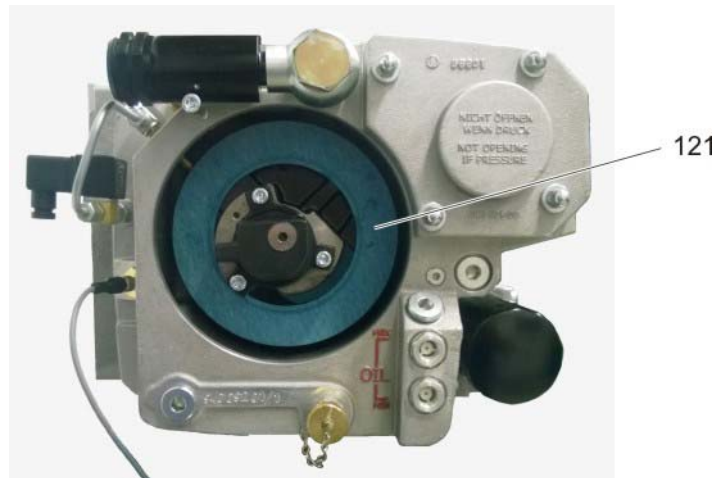
3. Remove the lid (120) and take out the air filter (126).



4. The air filter can be cleaned once if it is not too contaminated. For this, tap the air filter. Blow compressed air through the filter from the inside out.

## Maintenance

- Reinstall the cleaned or new filter. Here, ensure the correct seat of the seal ring (121) on the lid.



### 8.9 Oil filter (100/32)

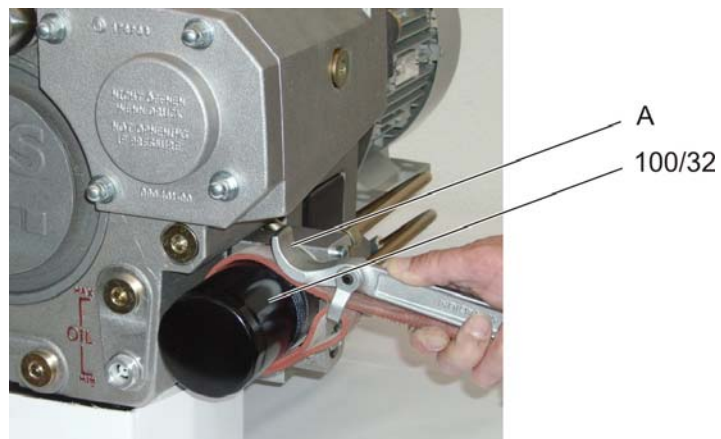


#### NOTE!

*Perform the filter change together with the oil change.*

Replace the oil filter as follows:

- Ventilate the safety valve. See page 54, Chapter 8.5.
- Drain the oil. See page 53, Chapter 8.4.2.
- Loosen and unscrew the oil filter cartridge (100/32) with a strap wrench or oil filter wrench (A) by turning it to the left. Dispose of the oil filter cartridge in an environmentally friendly manner.





4. Moisten the seal ring of the new oil filter cartridge with oil (B).



5. Turn the oil filter cartridge in to the right and tighten hand-tight (approx. 10 Nm).  
6. Fill the compressor with oil. See page 53, Chapter 8.4.2.

## 8.10 Oil cooler (190)



### **DANGER!** **Danger due to improper operation!**

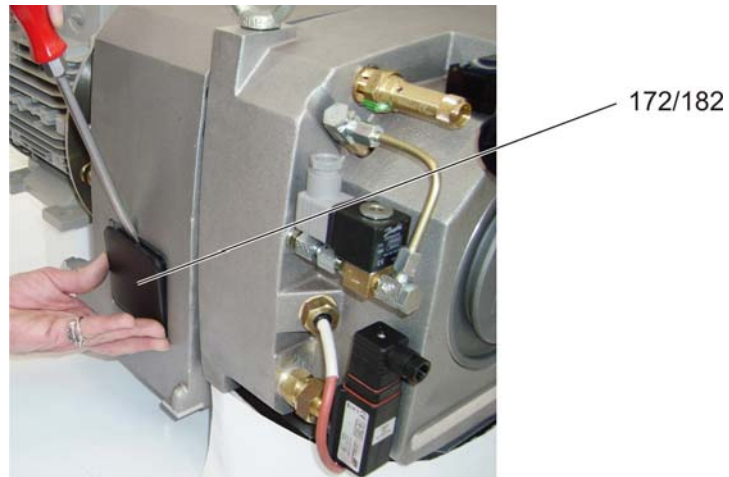
- Clean the cooler only with the system switched off.
- Protect system from being restarted (switch off drives).

## Maintenance

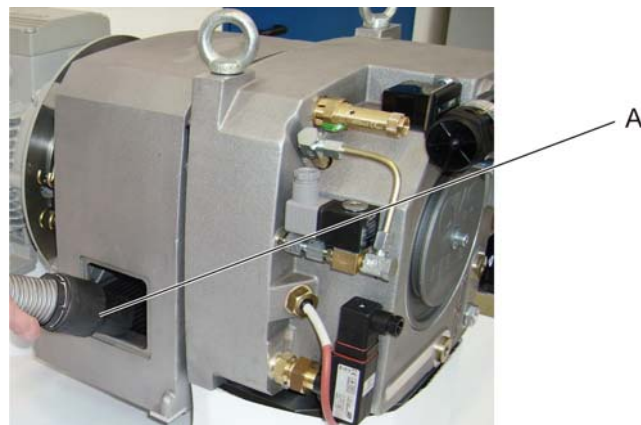
The oil cooler is installed in the intermediate flange on the compressor unit.

Clean the oil cooler as follows:

1. Remove the plastic cap.



2. Carefully clean the cooling fins. For this, blow the cooler with compressed air from the outside or suction it off from the inside with a vacuum cleaner (A).



3. Reinstall the plastic cap.

### 8.11 Air deoiler element (65)



#### **DANGER!**

#### **Danger due to improper operation!**

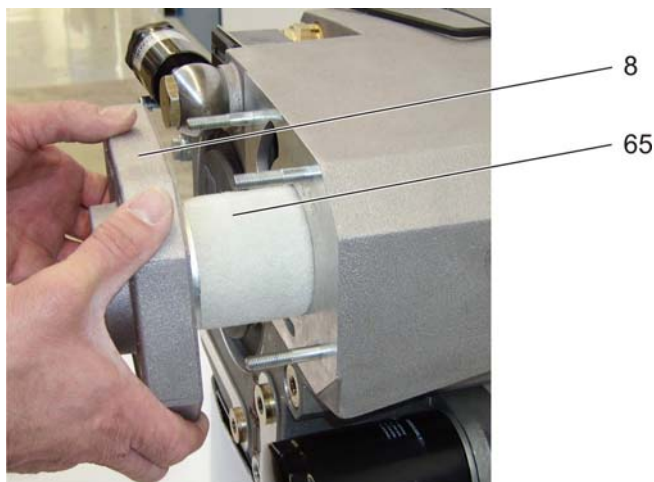
- Only replace the air deoiler element while the system is switched off and free of pressure.
- Protect system from being restarted (switch off drives).

Replace the air deoiler element as follows:

1. Ventilate the safety valve. See page 54, Chapter 8.5.
2. Remove the acorn nuts (70).



3. Remove the separator lid (8) with the air deoiler element (65).



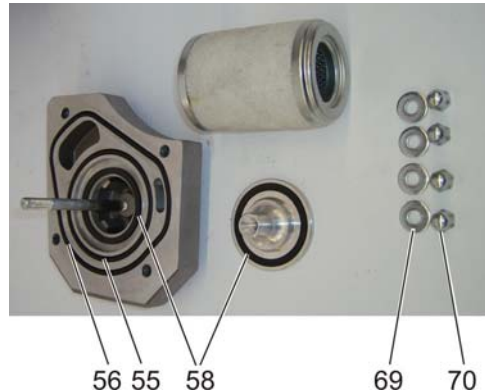
4. Unscrew the air deoiler element (65) from the lid by turning it to the left.



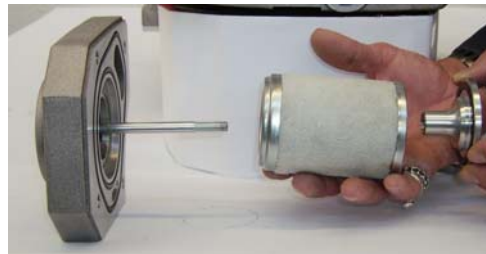


## Maintenance

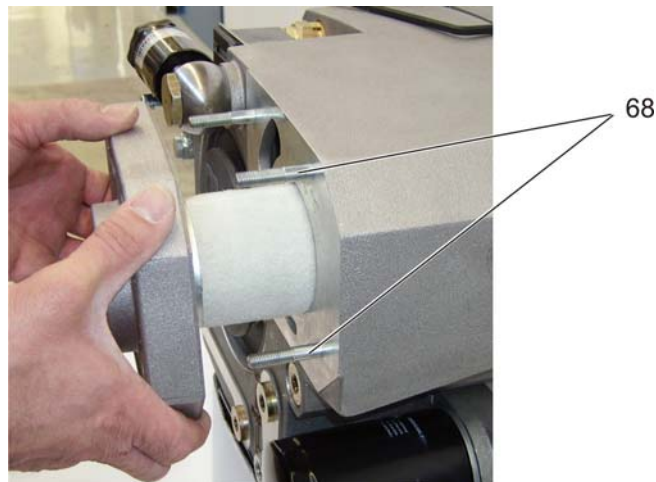
5. Also replace the O-rings (55) (56) and the flange seal (58).



6. Oil the O-rings and flat seals.
7. Install the air deoiler element manually onto the the locking lid (59) by turning it to the right. (Torque approx. 5 Nm)



8. Place the separator lid with the air deoiler element into the stud bolts (68).



9. Screw in the separator lid with deoiler element. Torque of acorn nuts (70): 23 Nm

## 8.12 Oil level monitor (227)

Check the oil level monitor as follows:

1. Ventilate the safety valve. See Page 54, Chapter 8.5.
2. Connect a suitable test lamp to the oil level monitor.
3. Drain the oil. See page 53, Chapter 8.4.2.
4. If the screw in height of the level monitor cannot be reached, the connected test lamp must trigger. If the level monitor does not switch, it must be removed, tested and replaced if needed.
5. Refill the oil. See page 53, Chapter 8.4.2.



*Fig. 24: Testing the oil level monitor*

A      Terminals (+ and –) to connect the test lamp

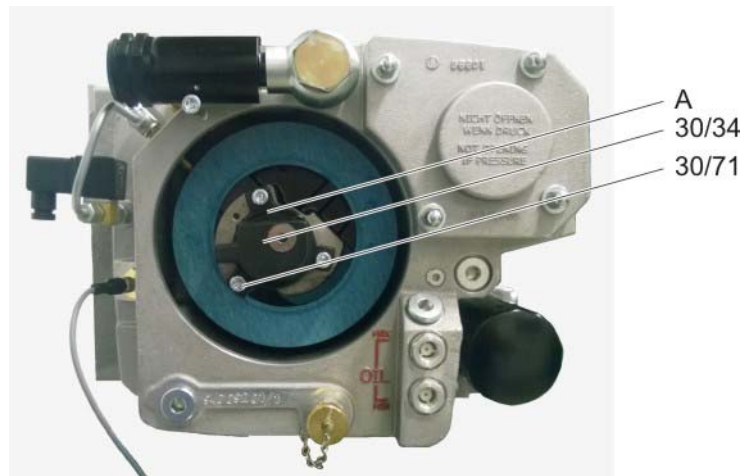
**Maintenance****8.13 Air suction regulator with non-return valve (30/55,57)**

When checking the air suction regulator with non-return valve, the round seal ring (65) may have to be replaced. An oily suction opening is an indicator for a leaking air suction regulator.

1. Ventilate the safety valve. See page 54, Chapter 8.5.
2. Unscrew the cylinder head screw (35). Remove the air filter lid (120).

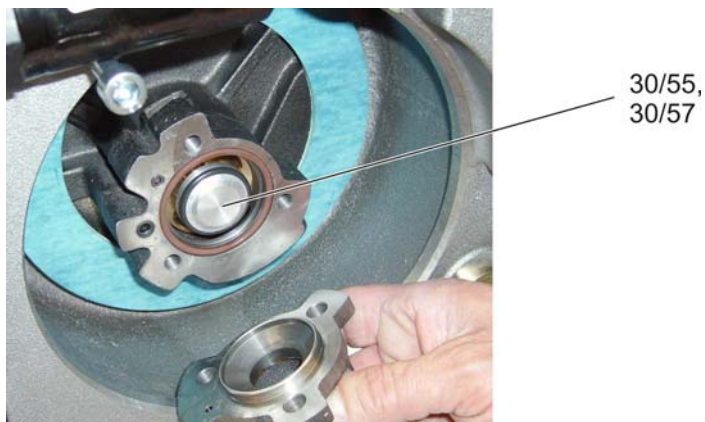


3. Remove the regulator lid (30/34) (3 cylinder screws, 30/71). (A: air suction opening)

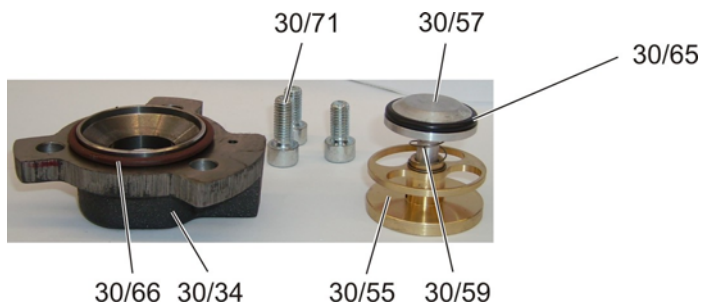




4. Remove the non-return valve (30/57) and the piston for the air suction regulator (30/55). Watch for the spring in the lid (30/59).



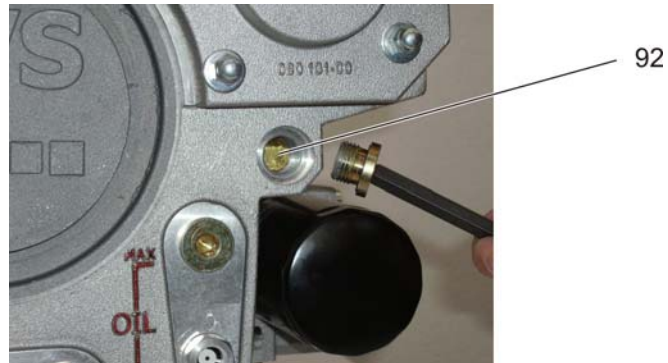
5. Test the round seal ring (30/65, 30/66) and replace if necessary.
6. The assembly is performed in reverse sequence.  
The torque for item 30/71 is 25 Nm.  
Oil the thread and the head rest.



**Maintenance****8.14 Oil suction nozzle with non-return valve (85)**

Replace the oil suction nozzle with non-return valve as follows:

1. Ventilate the safety valve. See page 54, Chapter 8.5.
2. Remove the locking screw (92).



3. Remove the sieve insert.
4. Use a wide tipped screwdriver to unscrew the oil suction nozzle with non-return valve.



5. Insert the suction nozzle with non-return valve.
6. Assembly in reverse order.

## 8.15 Minimum pressure non-return valve (150)

Test the minimum pressure non-return valve:

1. Switch the compressor on and let it run for about 5 minutes.
2. Relieve the pressure via the pressure side line segment (line to the minimum pressure non-return valve).
3. Ventilate the safety valve on the compressor after approx. 2 hours. Here, there should be enough of a pressure volume in the compressor so that it can be heard exiting the safety valve.

If there is no pressure volume when the safety valve is ventilated, the minimum pressure non-return valve is leaking. Replace the minimum pressure non-return valve.

A defective minimum pressure non-return valve will cause an increased residual oil content in the compressed air.

The set minimum pressure ex factory is approx. 2 bar<sub>g</sub>.

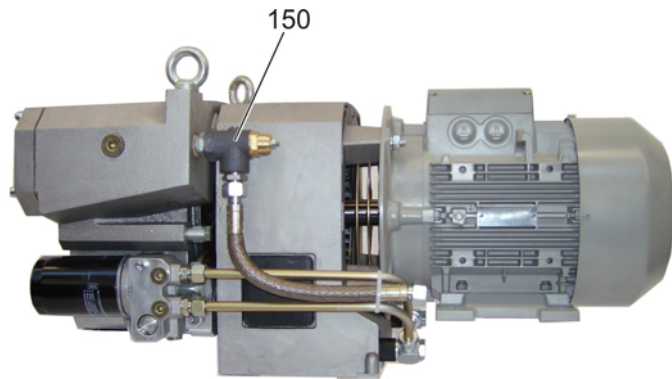


Fig. 25: Minimum pressure non-return valve

## Maintenance

### Design

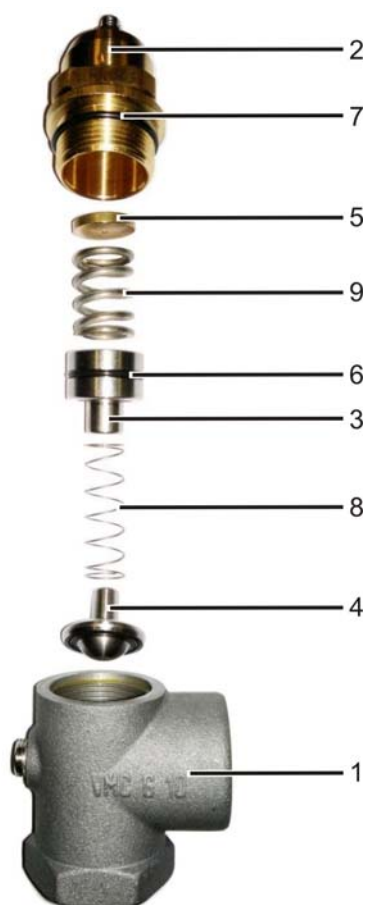


Fig. 26: Structure of the minimum pressure non-return valve

- 1 Casing
- 2 Cap
- 3 Piston
- 4 Non-return valve
- 5 Centring disc
- 6 O-ring
- 7 O-ring
- 8 Spring
- 9 Pressure spring

## Maintenance

After approx. 4400 operating hours or 2 years, clean the valve and moisten the guides with grease.

1. Relieve the compressor and compressed air system using the safety valves and electrically secure them against reactivation.
2. Remove the brass cap (item 2) at the minimum pressure valve (width across flats SW 28).  
**Attention!** Apply counter-torque at the minimum pressure valve housing (item 1) (width across flats SW 36).
3. Clean valve parts and moisten guides (item 3 + item 4) with grease <sup>1)</sup>.
4. Assembly in reverse order.

1) Grease type: Klüberplex BEM 34-132,  
CVS item no.: 530 010-00

After approx. 13000 operating hours or 6 years, replace the round seals (item 6) CVS-item no. 463 047-00 at the minimum pressure piston (item 3) and the round seal (item 7) CVS-item no. 463 054-00 at the minimum pressure valve housing (item 1).

## 8.16 Compressor step (30)

Usually, maintenance of the compressor step is not required.

CVS engineering recommends having the compressor maintained (over all) by specialised staff as a preventive measure after approx. 18,000 operating hours or after 8.2 years, CVS. If there are abnormal sounds coming from the compressor, have it tested by CVS engineering or one of their authorised workshops.

## Maintenance

### 8.17 Electric motor



#### CAUTION!

Observe the manufacturer's operating and maintenance instructions.

The maintenance of the drive motor is usually limited to the following:

- Checking the air passages
- Opening existing, closed condensate water openings.
- Testing the condition of the respective switches and connections.
- Replacing the roller bearings after 40,000 operating hours.

### 8.18 Hose lines and compensators

The function and standstill times of hose lines (oil line, e.g. when using external oil coolers) and compensators (flexible connection between the compressed air outlet on the compressor and the compressed air after cooler) can be impaired by vibration, exterior affects and aging.

Therefore, we recommend the following actions pertaining to all hose lines and compensators

- at least once a year
- in the course of maintenance procedures
- prior to restarting the system after lengthy storage

check the system for exterior damage, cracks and leaks and replace if necessary.

Furthermore, we recommend the preventive replacement of all hose lines and compensators every 13,000 operating hours or every 6 years (plus a storage period of one year), even if no safety-relevant damage is visible.

## 9 Malfuncions

### 9.1 Safety during troubleshooting

Refer to chapter 2.5 Safety!

#### Personal protective equipment

See Chapter 2.4.

#### Environmental protection

Observe the following information with regard to environmental protection during troubleshooting:

- Remove emerging, used or excessive grease at all lubricating points that are manually supplied with lubricant and dispose of in accordance with valid local regulations.
- Collect exchanged oil in suitable containers and dispose of in accordance with valid local regulations.

Never restart the compressor after it has been shut off due to a malfunction without checking the cause and remediating the error.

With malfunctions that cannot be alleviated by means of the following instructions, please contact the supplier (Addresses → page 2)!

Malfuncion:	Possible cause	Corrective action	Execution
<b>Compressor final temperature too high (max.: 100°C)</b>	Cooling air or suction air temperature too high	Ensure a better aeration and ventilation of the installation room.	Specialist
	Wrong oil used	Add oil as per specifications (Chapter 8.4.2).	Specialist
	Oil level too low	Check oil level and fill oil if necessary (Chapter 8.4.1).	Operator
	Oil filter (100/32) soiled	Replace oil filter (Chapter 8.9).	Specialist
	Oil very aged	Oil change. Clean all parts that came into contact with the oil. Replace oil filter and air deoiler element.	Specialist
	Oil cooler on the oil and cooling air side soiled	Clean oil cooler (Chapter 8.10).	Specialist
	Thermostat valve in oil circuit defective	Check thermostat valve and replace if necessary.	Expert /electrical specialist

## Malfuncions

Malfuncion:	Possible cause	Corrective action	Execution
<b>Volume flow too low</b>	Air suction regulator with non-return valve (30/55, 30/57) will not open	Remove air suction regulator with non-return valve and test (Chapter 8.13)	Specialist
	2/2-way solenoid valve will not close	Check the 2/2-way solenoid valve and replace if necessary	Expert /electrical specialist
	Wrong oil used	Change oil as per specifications (Chapter 8.4.2).	Specialist
	Air suction filter (126) plugged	Clean filter and replace cartridge (Chapter 8.8).	Specialist
	Air suction cyclone	Check the air suction cyclone and clean if necessary (Chapter 8.6).	Specialist
	Relief valve (supplied on-site) will not close	Check the pressure monitor (supplied on-site) and the relief valve	Expert /electrical specialist
<b>Strong oil-discharge at the compressed air consumer point</b>	Sieve (88) in the suction line soiled	Clean sieve (Chapter 8.7).	Specialist
	Nozzle with non-return valve (85) in the oil suction line obstructed or non-return valve	Remove the nozzle with non-return valve and check. Clean or replace the entire set if necessary.	Specialist
	Air deoiler element (65) contaminated, defective or incorrectly installed (O-ring seal)	Check air deoiler element and replace if necessary. Ensure the correct seating of the air deoiler element (Chapter 8.11).	Specialist
	Wrong oil used	Change oil as per specifications (Chapter 8.4.2).	Specialist
	Strong pulsation in the compressed line, e.g. by air dryer	Refit the pulsation damper and/or fine separator. (Chapter 6.12)	Specialist
<b>Suction regulator with non-return valve does not close or open</b>	2/2 way solenoid valve (220) defective	Check the 2/2-way solenoid valve and replace if necessary	Expert /electrical specialist
	Pressure monitor (on site) defective	Check pressure monitor and replace if necessary.	Expert /electrical specialist
	Regulating piston (30/55) with non-return valve (30/57) is stuck.	Remove the regulator piston and ensure smooth, unobstructed movement.	Specialist
		Have the compressor refitted by an authorised workshop.	authorised workshop



## Malfuncions

Malfuncion:	Possible cause	Corrective action	Execution
<b>Uneven run of compressor</b>	Oil very aged	Change oil, remove compressor, test and clean all parts that have been in contact with oil. Replace oil filter and air deoiler element (Chapter 8.4.2). Clarify the reason for the malfunction and alleviate it.	Specialist
	Bearing defective, rotor vane or casing defective	Have the compressor refitted by an authorised workshop.	authorised workshop
<b>Compressor is switched off or cannot be turned back on.</b>	The pressure monitor (on site) has switched off the compressor.	Check the pressure monitor settings and correct if necessary.	Expert /electrical specialist
	Final temperature too high, temperature safety switch (connected on site), switched off the compressor when 110°C was reached.	Ensure better room ventilation.	Operator
		Clean oil cooler (Chapter 8.10).	Specialist
		Change oil as per specifications (Chapter 8.4.2).	Specialist
		Replace oil filter (Chapter 8.9).	Specialist
	The overcurrent relays or the cold conductor sensor of the drive motor have been triggered.	Check the thermostat in the oil circuit and replace if necessary.	Expert /electrical specialist
		Room temperature or cooling air temperature on the motor too high. Ensure better ventilation.	Operator
<b>Oil leaking from the drive shaft of the compressor.</b>	Radial shaft seal leaks	Have the compressor refitted by an authorised workshop.	authorised workshop
	Slide ring seal of the drive shaft defective	Have the compressor refitted by an authorised workshop.	authorised workshop
<b>Oil escaping from the air suction regulator</b>	Non-return valve is stuck	Remove and test air suction regulator with non-return valve. Replace if necessary (Chapter 8.13).	Specialist
	O-ring (30/65) of the suction non-return valve damaged	Replace the entire air suction regulator with non-return valve (Chapter 8.13).	Specialist

## Malfunctions

Malfunction:	Possible cause	Corrective action	Execution
Motor shows changes compared to normal operation (such as noises)	See "Motor" operating instructions. Contact motor manufacturer if necessary.		

## 10 Spare and maintenance parts

### Customer service

In case of queries regarding the product, spare part orders, repairs, replacement machines and dispatch of fitters, please contact our customer service: Phone.: +49 (0) 7623 71741-31

### Data for ordering spare parts and maintenance parts

Always mention the following information when ordering spare parts:

Data	Example
Order no. <sup>1)</sup>	100208
Year built <sup>1)</sup>	2008
Machine type <sup>1)</sup>	RPO 600 LA
Machine no. <sup>1)</sup>	L10007-00
Spare parts list no.	
Item no.	
Part no.	432700-00
Quantity	1
Designation	Air deoiler element
Order no. <sup>1)</sup>	100208

Table 9: Data for spare parts ordering

<sup>1)</sup> Data see rating plate of compressor

The following drawings show all individual parts needed for the assembly. By indicating the item no. and the size of the compressor, these parts can be allocated.

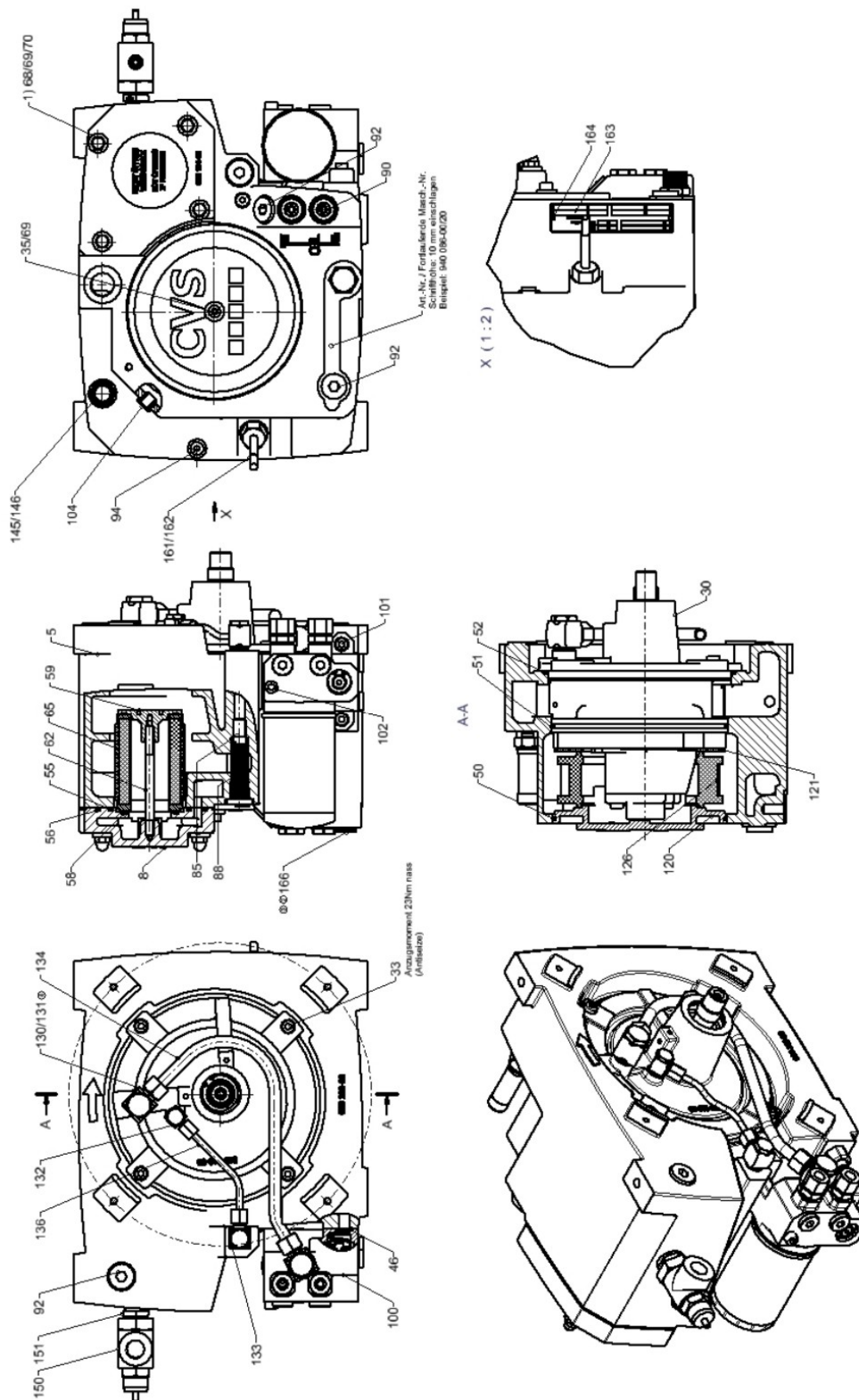
Model	Drawing no.	Designation	Drawing no.: item no. used
RPO 200 –RPO 800	940086-00	Assembly drawing - compressor	940086-00: 1...170
	940071-00	Step	940086-00: 30- 940071-00: 31...80
	940040-00	Oil temperature regulator	940086-00: 100- 940040-00: 5...30
	250176-00	Assembly drawing - unit and accessories	250176-00: 171...260

### Example: Item no.30/48

30: Main parts list: compressor

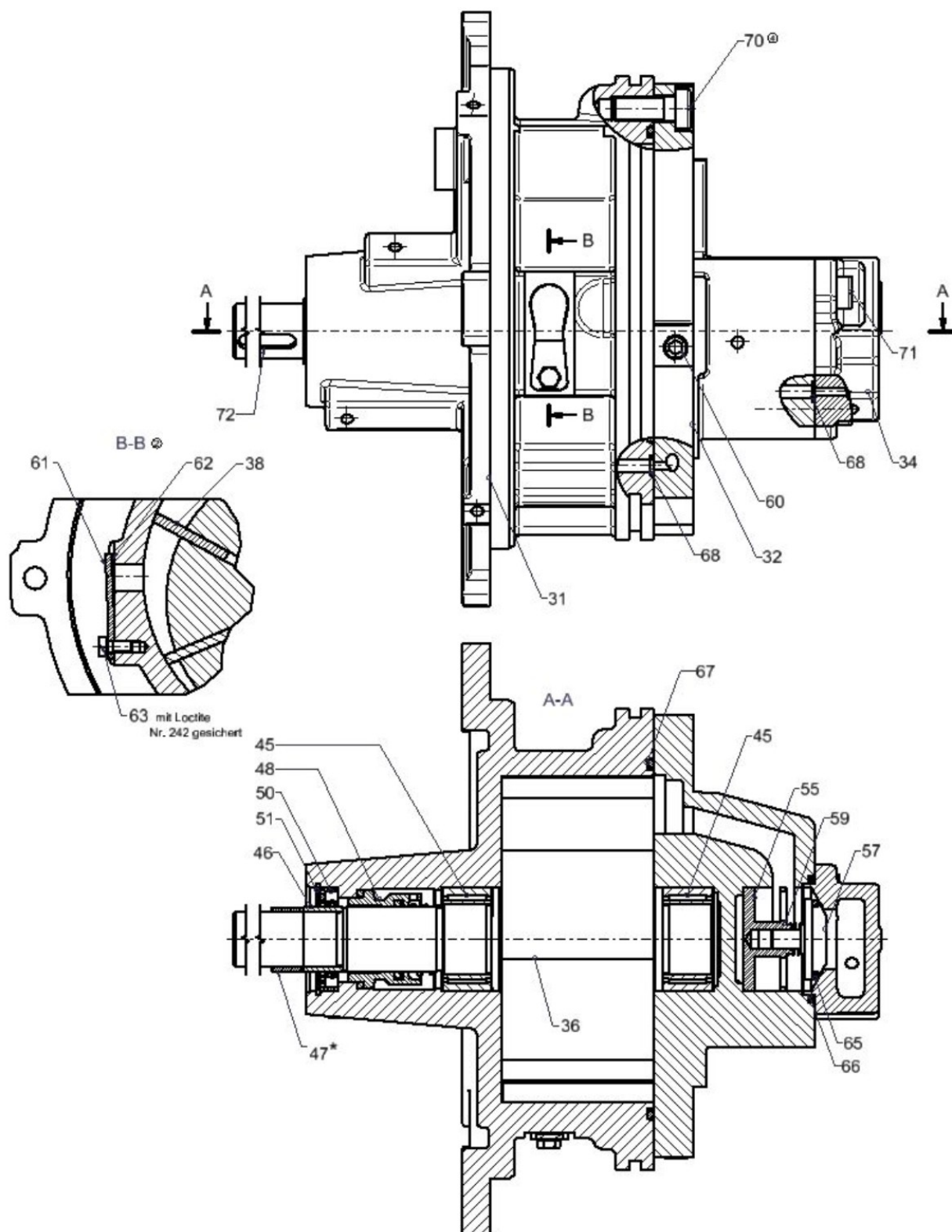
48: Sub parts list: Slide ring seal

### 10.1.1 Assembly drawing of compressor RPO 200...800 (drawing no.: 940 086-00)



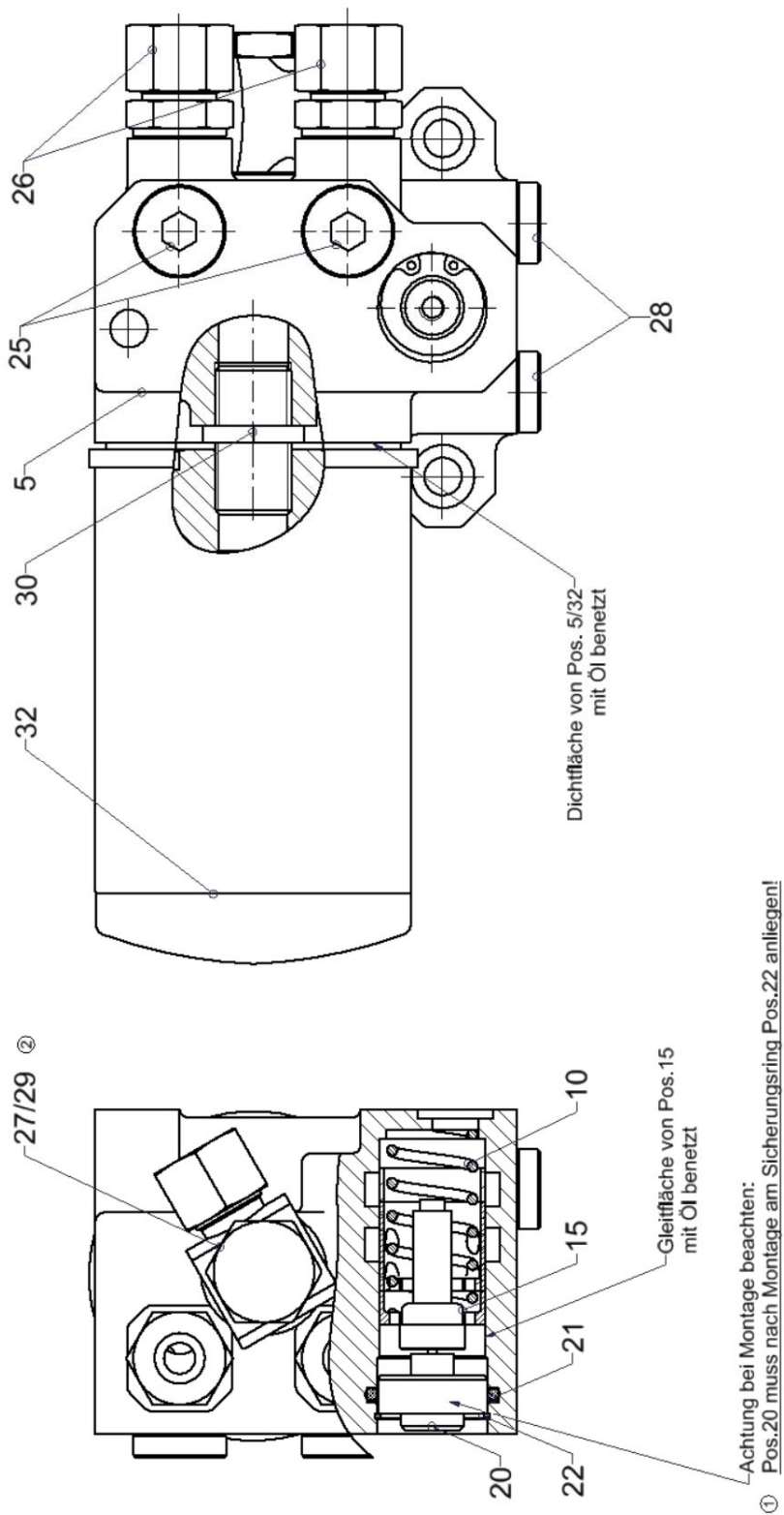
Status 05.20014

### 10.1.2 Compressor step RPO 200...800 (drawing no.: 940 071-00)



Status 05.2014

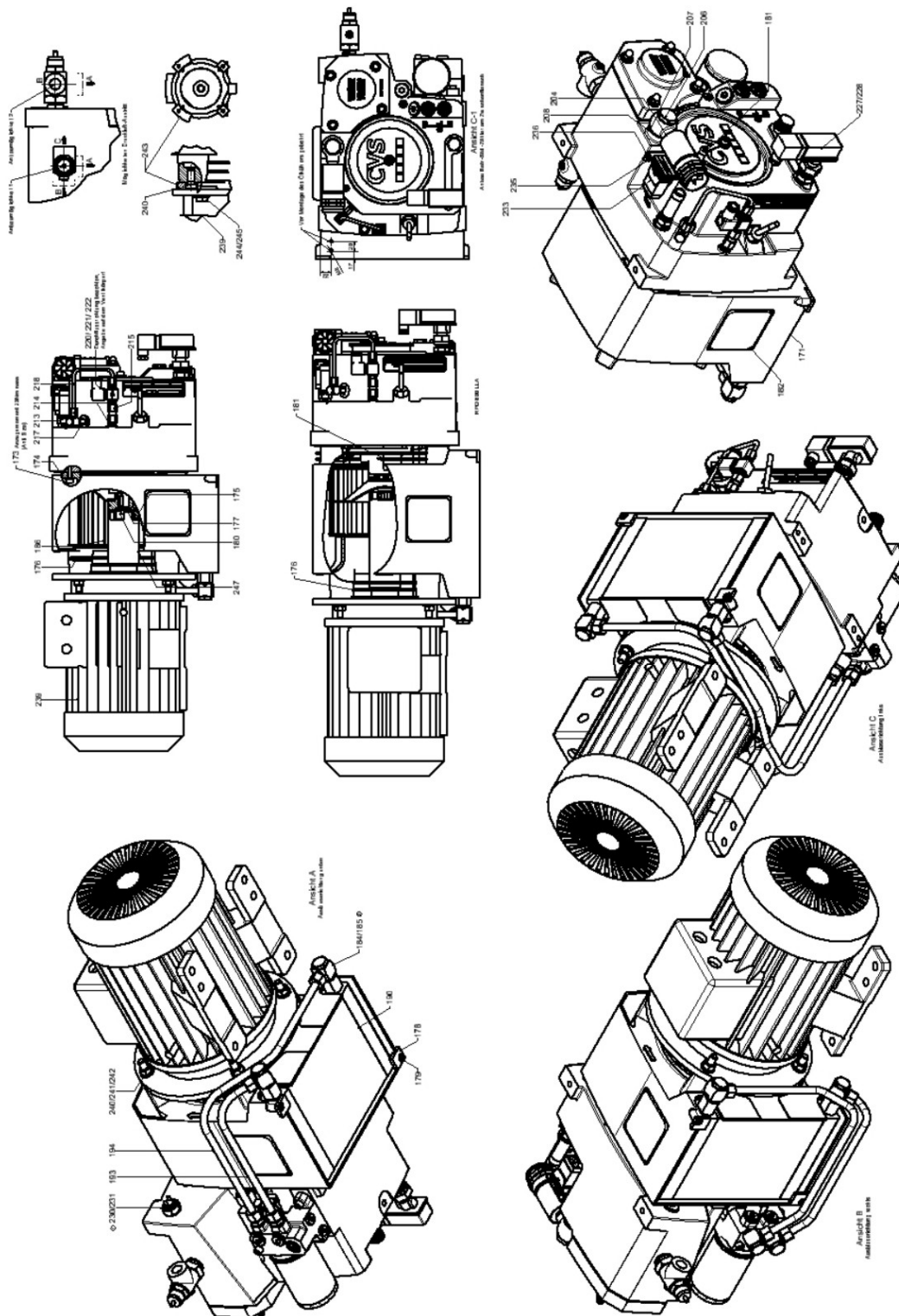
### 10.1.3 Oil temperature regulator RPO 200...800 (drawing no.: 940 040-00)



Status 05.20014



### 10.1.4 Assembly drawing of unit and accessories RPO 200...800 (drawing no.: 250 176-00)



## Spare and maintenance parts

### 10.2 Maintenance parts

Item no.	CVS part no.		Qty/compressor	Designation	Dimensions		Use
	RPO 200 – RPO 600	RPO 800			RPO 200 – RPO 600	RPO 800	
126	432 055-00		1	Air suction filter	12/175 x 65		Air suction filter
50	463 260-00	463 268-00	1	Round sealing ring	176 x 3	187 x 3	Seal of air filter lid
100-32	432 500-00		1	Oil filter	120 x 75		Oil filter
65	432 700-00	432 701-00	1	Deoiling element	72 x 99	72 x 151	Deoiling element
55	463 135-00		1	Round sealing ring	80 x 4		Inner seal of deoiler element
56	463 178-00		1	Round sealing ring	118 x 4		Exterior seal of deoiler element
58	465 059-00		2	Flat seal	50/60 x 2		Seal under deoiler element
85	940 038-00		1	Non-return valve with nozzle	1/4" x 27		Oil suction line
88	432 929-00		1	Sieve	–		Oil suction line
92	440 402-00		1	Locking screw	G 1/2"		Oil drain and oil fill screw
30-65	463 060-00	463 080-00	1	Round sealing ring	26 x 3	34 x 3	Non-return valve for suction regulator
30-66	463 110-00	463 116-00	1		45 x 3	51 x 3	Lid of suction regulator
30-68	463 010-00		1		5 x 1,5		Suction boring
150-6	463 047-00		1		19 x 1,8		Minimum pressure non-return valve
150-7	463 054-00		1		24 x 1,8		

Table 10: Maintenance parts



## 11 Decommissioning and disposal

**Safety**

Refer to chapter 2.5 Safety!

**Personal protective equipment**

See Chapter 2.4.

A compressor that is no longer usable should not be recycled as complete unit, but disassembled into individual components and recycled according to material types. Non-recyclable materials have to be disposed of in an environmentally compatible manner.

- Prior to decommissioning and disposal of the machine, it must be completely separated from the surrounding units.
- The machine must only be disassembled and disposed of by specialised staff.
- The machine has to be disposed of in accordance with the respective country-specific regulations.

# EC Conformity Declaration for Machines

(pursuant to EC-Machinery Directive 2006/42/EC, Annex II A)



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Germany

Herewith, the manufacturer declares that the machine type: **Sliding vane compressor RPO 200/300/400/600/800-LA/LLA** complies with the basic safety and health requirements of the directive 2006/42/EC up to the interfaces described in the enclosed operating instructions, data sheets and technical documentation.

When installing the machine into another machine (such as a streetcar/vehicle), all instructions and safety regulations listed in the operating and installation instructions must be observed.

The technical documentation according to Annex VII A of the Directive is available for a possible inspection by the responsible supervisory body.

The technical documentation belonging to the machine according to Annex VII A of the Machinery Directive has been compiled.

## **Machine description:**

### **RPO 200/300/400/600/800-LA/LLA:**

- > Sliding vane compressor, one-step with oil injector cooling, air-cooled, for the compression of cleaned, atmospheric air, for direct drive via coupling, driven by AC motor or DC motor or hydraulic motor.
- > Operation modes: LA = Load intermittent duty, LLA = Load idle intermittent duty

## **Applied harmonized standards:**

- > DIN EN 1012-1  
Compressors and vacuum pumps, safety requirements, Part 1: Compressors
- > DIN EN ISO 12100-1 + -2  
Safety of basic machine terminology, general design guidelines  
Part 1: Basic terminology, methodology  
Part 2: Technical guidelines
- > DIN EN ISO 14121-1  
Safety of machinery / Risk Assessment Part 1: Principles
- > DIN EN 15085 Parts 1, 2, 3, 4, 5  
Railway applications: Welding of railway vehicles and components

## **Apart from the directive mentioned, the product complies with the following European directives:**

- > Low-voltage guideline 2006/95/EC of the European Parliament and Council dated 12/12/2006
- > Directive electromagnetic compatibility 2004/108/EC of the European Parliament and Council dated 12/15/2004
- > Directive electric and electronic old devices 2002/96/EC of the European Parliament and Council dated 01/27/2003
- > Directive 2002/95/EC of the European Parliament and Council dated 01/27/2003 to limit the use of certain hazardous substances in electric and electronic devices **(RoHS)**

**Refitting or modifying the machine as a whole, or on individual components, will void the validity of this declaration!**

A handwritten signature in black ink, appearing to read 'H. Lütte', written in a cursive style.

Rheinfelden, December 02, 2009

p.p. Hans Lütte  
Design & Marketing

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